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# Small Business Survey: Linking 2006 and 2007 waves to the IDBR

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# Contents

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# 1. Overview

This report describes work to link two waves of the Small Business Survey (SBS) to the Inter-Departmental Business Register (IDBR)[1]. The first is the Annual Small Business Survey 2006/07, hereafter SBS 2006; the second is the survey for 2007/8, hereafter SBS 2007. The linking work has been undertaken by Belmana and Middlesex University; IFF Research conducted both surveys and has overseen this work.

The focus of this research was to understand the strengths and weaknesses of different methods of linking and then develop an approach for application to the 2006 and 2007 waves of the survey. A particular difficulty, as older waves of SBS are linked to the IDBR, is the changes to businesses that would have occurred since the survey. This work has taken steps to reduce the effect of the age of the survey on the quality of the data linking, by linking to historic vintages of the IDBR and the Companies House register.

The report also reviews earlier work by the Office for National Statistics (ONS) linking the 2010 and 2012 SBS surveys to the IDBR. The project draws on insights from this, but introduces new linking methods that improve link rates. Various quality checks have been undertaken and, given the surveys were conducted almost a decade ago, the ability to link a higher proportion of respondents to the IDBR than achieved for the 2010 survey indicates the linking of SBS can be undertaken even for relatively old waves. Some preliminary analysis of the linked survey data suggests that there is potential for understanding the more long-term outcomes for businesses and correlating these with SBS responses.

The report is structured to cover:

1. **Review of the SBS 2010 and 2012 Linking:** This reviews the two waves of the Small Business Survey that are already accessible for researchers within the ONS Virtual Data Lab (VML), focusing on the 2010 wave that was linked to the IDBR by ONS. The results of this data linking exercise are briefly described.

2. **Linking the 2006 and 2007 SBS to the IDBR** presents the results of the current project. It describes the fuzzy linking that has been used to link the surveys to the Companies House register and to the IDBR.

3. The **quality of the data linking** is then assessed through both quantitative and qualitative tests. Three approaches to quality are taken, a first checks whether the areas where linking rates are low are consistent with expectations. Then, the section looks at the results of some manual checking of samples of records that were not linked and a sample where linking was successful. Lastly, a quality measure is derived, which uses the distance between IDBR and survey postcodes as validation. Potential bias**,** derived from differential linking rates across key variables such as business age, size and sector, is assessed and the probability of being successfully linked to the IDBR is modelled.

[1] The matched datasets are now available in the VML.

4. **Comparing SBS responses to ONS data** uses the linked data to compare business responses to survey questions to comparable variables found in the IDBR data. The focus is on differences between employment levels recorded in the ONS Business Structures Database and in the survey waves, as well as the reliability of self-reported expectations regarding employment growth. Some analysis of turnover is also reported.

5. **Analysis of business demography and growth drivers** uses the Business Structures Database to analyse what has happened to businesses that were surveyed in SBS 2006 and 2007. As expected, the recession led to a number of business closures and the section models possible drivers for this at a firm level. The section also looks at the relationship between respondents' answers to questions about productivity drivers – such as innovation activity – and firm growth.

# 2. Previous Linking of the Small Business Surveys

## Summary

The approach used to link SBS 2006 and SBS 2007 builds on recent ONS work linking the 2010 and 2012 Small Business Surveys to the Inter-Departmental Business Register (IDBR). The ONS work was conducted in the last few years and so benefitted from being undertaken relatively soon after the survey. For SBS 2010, the linking used the ONS business register in a comprehensive manner, applying powerful name and address linking algorithms, so that a high linking rate was possible. However, the 2012 linking used a relatively crude linking strategy and so the number of survey responses satisfactorily linked to the IDBR was modest.

From 2014 onwards, the SBS has been using the IDBR as a sampling frame. This means that future waves of the survey will be easily and accurately linked with ONS datasets.

## Review of the SBS 2010 Linking

BIS commissioned IFF Research to conduct the SBS 2010. The purpose was primarily to monitor the characteristics and perceptions of small business owners and managers, and how these have changed in comparison to previous surveys. The survey was conducted between 2 July and 7 September 2010.

BIS commissioned 4,000 computer assisted telephone interviews (CATI) for SBS 2010, which were selected in proportion to UK regions. In addition, the Welsh Assembly Government (WAG) commissioned a further 580 interviews as a boost, making a total of 4,580 interviews. There were also boosts for women-led businesses and ethnic minority led businesses. Samples were drawn from the Dun and Bradstreet (D&B) database.

Within each of the four UK countries (England, Wales, Scotland and Northern Ireland) strata targets were set according to size of business. Approximately one sixth of interviews in each country were conducted with enterprises with no employees; one-third with micro businesses (one to nine employees); one-third with small businesses (10-49 employees); and one-sixth with medium-sized businesses (50-249 employees). No other targets were set, e.g. by sector. The sample was then randomly drawn across all commercial sectors and legal structures of the UK economy, from the Dun & Bradstreet database.

Respondents to the Small Business Survey 2010 were asked the following question (Q202a):

> *Would it be possible for BIS to match your responses to other information that you have provided previously to the Government? By this data matching, we can reduce the burden of our surveys on your business and can improve the evidence that we use.*
>
> *Data will only be used to inform research on businesses in aggregate - we will never release information that identifies any individual business - and your survey responses remain strictly confidential. Do you give your consent for us to do this?*

4,006 respondents (87 per cent) said they would be willing to have their responses linked to other data. In instances where individuals indicated they would allow data linking ONS attempted to links the enterprise information held by IFF for SBS 2010 respondents and the enterprise information held by ONS on the IDBR. Where links were found ONS appended IDBR reference numbers to the SBS 2010 database. ONS links by constructing a standardised version of business names, postcode and a trade style indicator (sole proprietor/limited company). Names are cleaned, removing unnecessary punctuation, harmonising to capitals and removing some very common words or standardising the spelling.

For SBS 2010, ONS were able to link 2,884 records to the IDBR. This represents a link rate of 72 per cent of those willing to be linked. Taking into account the proportion that did not wish to be linked, 63 per cent of records on SBS 2010 have appended IDBR reference numbers. ONS note that users should be aware that there has been selection in two stages: self-selection at the survey stage, and selection at the linking stage.

**Table 1: ONS Linking of SBS 2010 by Size of Business**

| | Unlinked | Linked | Total | **Unlinked** | **Linked** |
|---|---|---|---|---|---|
| **No employees** | 441 | 317 | 779 | 57% | 43% |
| **Micros (1-9)** | 543 | 981 | 1,511 | 36% | 64% |
| **Small (10-49)** | 475 | 1,067 | 1,511 | 31% | 69% |
| **Medium (50-249)** | 237 | 519 | 779 | 30% | 70% |
| **Total** | 1,696 | 2,884 | 4,580 | 37% | 63% |

Note: Total count and percentages reported separately.

Particularly at the stage where SBS 2010 records were linked to the IDBR there is reason to believe that larger and more established enterprises are more likely to be linked. This is because the very smallest enterprises are less likely to be on the IDBR, where enterprises appear if they are registered for VAT and/or PAYE. Table 1 supports this assertion, where the link rate rises from 43% in businesses with no employees to 70% in medium sized businesses. This means that the enterprises on the SBS 2010 that are available for conducting analysis are not representative of those in the wider business population, thus rendering the survey weights of less use for the researcher.

It is noted from this initial look at the SBS2010 linking that the link rate is high. However, it also seems to be the case that there is room for improvement, especially when looking at the group of medium and small businesses that remain unlinked. Linking such businesses should be relatively easy. Linking the SBS2006 and 2007 has sought to explain and improve link rates in these business categories.

## Review of the SBS 2012 Linking

ONS also linked the SBS2012 and this is also accessible through the Virtual Microdata Lab (VML). This survey used the same D&B sampling frame as for the 2010 survey and aimed at reaching a similar composition of businesses as prior surveys.

The VML team within the ONS was provided with a list of Companies House registration numbers on the surveyed businesses, which was then linked to the IDBR enterprise reference. The link rate is much lower than that achieved for the SBS2010. Of the 5,724 businesses surveyed, 4,721 respondents agreed to have their information linked to

administrative data (82.4 per cent), and 1,809 of these were linked to an IDBR reference within the VML. This is a link rate of 38 per cent, just over half of the rate achieved on SBS2010.

Two issues explain the poor link rate. Firstly, the 2012 survey was linked relatively soon after the survey had been conducted. The register to which SBS is linked may not include the newer businesses that were surveyed, as there is a lag between businesses starting up and then registering. This is not thought to be a major problem, as the SBS usually selects relatively few new businesses. Secondly, linking to Companies House leaves out sole proprietors and other non-incorporated entities linkable through the IDBR register. Since the SBS is known for surveying many non-incorporated entities, this reduces the link rates considerably.

# 3. Linking SBS 2006 and 2007 to the IDBR

## Summary

SBS2006 has 9,905 surveyed businesses, of which 8,640 agreed to have their data linked (87.3 per cent). For the SBS2007, those numbers are 9,362 and 7,985 (85.3 per cent) (Williams and Cowling, 2009)[2]. The surveys were commissioned by the Department for Business Innovation and Skills (BIS was then the Department for Business, Enterprise and Regulatory Reform). IFF Research conducted the surveys, following the same sampling strategy as outlined for SBS 2010 in Section 2.

Similar Small Business Surveys had been conducted for the years 2003, 2004/5, and 2005/6, with the target population being small and medium-sized enterprises (SMEs) defined as having less than 250 employees. As with other waves of the SBS, the sample was drawn from the Dun and Bradstreet business register. The 2006 survey was conducted between November 2006 and March 2007. SBS 2007 was conducted a year later. Sample sizes were almost double the more recent waves and boosts were included for Scotland and some of the regions of England.

The main challenges for linking these surveys to the IDBR are around the age of the survey. Many businesses that were surveyed would no longer be operating or would have changed ownership or address. Such changes are exacerbated by the recession, where business restructuring and closures became more pronounced. This necessitates the use of old versions of the registers for linking and puts a premium on registers that accurately manage the demographic changes a businesses may go through. It also limits the extent to which clerical checking is possible, using live databases and search systems.

**Table 2: Final linking rates for Small Business Survey waves**

| | SBS 2006 | SBS 2007 | SBS 2010 | SBS 2012 |
|---|---|---|---|---|
| **Total surveyed** | 9,905 | 9,362 | 4,580 | 5,724 |
| **Available for linking** | 8,640 | 7,985 | 4,006 | 4,721 |
| **IDBR enterprise references linked** | 6,694 | 5,843 | 2,884 | 1,809 |
| **Link rate (%)** | 77% | 73% | 72% | 38% |

Table 2 indicates the results of this project's linking of SBS to the IDBR in the 2006 and 2007 waves of surveys and compares this with that achieved for the 2010 and 2012 surveys by earlier work. Compared with the IDBR linking of the 2010 survey, linking rates for SBS 2006 and 2007 are higher. Linking of the SBS 2012 is not directly comparable, as the linking method used differs from the one used for the SBS 2006, 2007 and 2010.

[2] 8,105 businesses did agree to be linked, but the number of businesses with ID data for linking was lower.

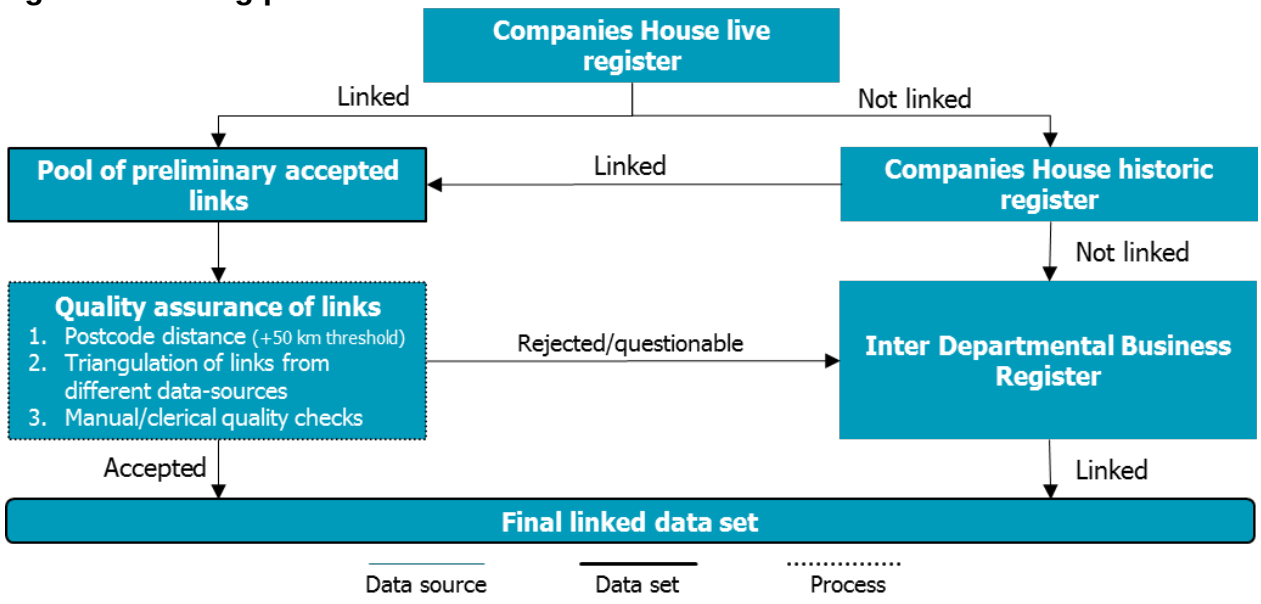
As the achieved link rates are high and the 2006 and 2007 surveys were almost twice the size of the 2010 survey, the number of businesses successfully linked to the IDBR is more than double that available to analysts of the SBS 2010.

The final link rates for SBS 2006 and 2007 were not achieved through a single method. Multiple methods were tested on the datasets. This provides two lessons. Firstly, comparing the links achieved through different methods ensures robustness of the link. Secondly, there is value added by using linking techniques in a manner that is tailored to the register being used. For example, different registers treat the history of business change differently and the linking exercise can then adapt to the strengths of some of the registers.

## Linking Approach

The flowchart, Figure 1, outlines the approach for linking SBS 2006 and 2007. It shows the use of the different data sources used for linking: the live Companies House register, a historic Companies House register from an online database and the Inter-Departmental Business Register. As each dataset lends itself to different methods of linking, the use of three different data sources has enabled to test the strength and weaknesses of each separately[3]. Then comparison across links found through different methods and different datasets ensures robustness of the final linked data (i.e. similar links across different sources were considered a verification).

**Figure 1: Linking process for SBS 2006 and 2007**




Using different data sources and methods does complicate the linking compared to more conventional methods. To simplify the process, a hierarchical strategy has been developed to prioritise between the links achieved by the different methods/data sources. The research team was provided the micro data for the 2006, 2007 and 2010 surveys with identification information for those businesses that agreed to be linked. The SBS data was

[3] The strengths and weaknesses of each data source can be found in Annex C.

then linked to different vintages of the Companies House register using fuzzy record linkage. It was then linked to the IDBR focusing on those businesses that could not be identified on the two versions of the Companies House register[4].

The identifier information in the SBS sometimes included Companies House register numbers. However, for the majority of businesses, identification information was limited to the name of the business, its location and other characteristics – such as industry – that could be used to corroborate links.

Even where the name and location was provided for the survey, these were rarely the same as that used on official registers even when the business was the same. A word in the business name may be abbreviated or a punctuation mark added. Fuzzy linking is an approach that links the surveyed businesses to registers accepting this constraint. Fuzzy linking algorithms were used on all three data sources in Figure 1. The closeness of the names or other linking fields is then scored with a score of one representing a perfect link.

Prior to the linking, survey identifiers about business names were “tidied up”. The process of cleaning business names in Stata has been formalised by Wasi and Flaaen (2014). Their commands *stnd_compname* allows analysts to parse and standardise company names and addresses, splitting the string variable containing company names or addresses into five components: (1) official name; (2) Doing-Business-As name; (3) Formerly-Known-As name; (4) business entity type; and (5) attention name. It does this using standard, exhaustive lists of standardisation rules that can be manually changed. The list of rules applied can be found in Annex B, Table B11.

Running this command on both SBS data and the register used for linking was a first step in the process. The code harmonises and truncates common terms often found in business names, to lower their influence on the link score (i.e. Contractors becomes CONTR). It removed obvious errors and adjustments made to harmonise punctuation such as spacing and use of full stops. Case sensitivity is avoided by capitalising. Also, terms referring to business entity types are put in a separate variable that is used as a separate linking variable.

Linking extended beyond the name fields. This was to minimise invalid linking. For example, if the business is not registered at Companies House, the name the business operates under may be very similar to one that is registered, resulting in an incorrect link. The fuzzy linking used business name but also incorporated the postcode of the business, business entity type and other descriptors to increase the confidence of the linking.

## Linking to Companies House (Live and Historic)

The first data source tested was the publicly accessible live Companies House register[5]. This was the only data source used in the SBS2012 linking. A problem with linking directly

[4] Hereafter, businesses are all entities being surveyed (including self-employed and sole proprietors), and companies are those registered with Companies House (Ltd, PLC, CIC, LLP etc.).

[5] As this data source is publicly available linking was undertaking in Stata 13, using the *reclink2* command as explained in Wasi & Flaaen (2014). The same method was used for linking with the IDBR dataset, only here the companies and businesses were linked separately. Business name, entity type and postcode were used, and different combinations of variables were tested. See Annex A for a description of different strategies on use of variables.

to the live Companies House register is that dissolved companies will remain unlinked. This problem is quite substantial given the age of the two surveys, and is exacerbated by the considerable exit seen due to the recession. To improve the linking, approaches have been developed that would link to companies dissolved between 2006 and 2014. This used Google Refine Reconciliation API[6] on the Opencorporates.org dataset.

The Refine Reconciliation API links company names to corporate entities on the Opencorporates.org register. Opencorporates.org holds a historic record for all Companies House entries, allowing linking not only to active companies, but also to dissolved ones. The proprietary API provides a very strong linking algorithm judging by the quantity and quality of achieved links. It effectively recreates the Companies House register of 2006 and 2007, identifying live businesses at the time of the SBS waves.

The API returns a linking score with each possible link result, based on the similarity of the company name. The algorithm takes account of the year of the survey and this changes the fuzzy scoring behaviour, meaning that a company will score higher if it was active at that date, and score significantly lower if it did not yet exist, or was inactive at that date. This was used to link data from the past, giving confidence that companies were relevant to the date of the survey. Many potential problems are solved. First of all, by adding a date, companies that have changed their name over time can be identified. Secondly, dissolved companies weigh as much as those that are currently active. This feature is an improvement to the algorithms available for IDBR linking and proved a very useful innovation for linking of historical data.

The algorithm derives up to three link options, sorted in the order of the similarity using the linking score. Where the scores are high for the best link (above 90 % similarity), then this was considered to be the successful link; where scores were very low then no linking to a CRN was made. Clerical linking was undertaken for intermediate scores.

This recent innovation in linking software provides a strong starting point. The link rates are significantly increased compared with linking to the live Companies House register (See Annex C for link rates) and the API linking algorithm on company name seems to be stronger than those available within statistical packages often used when linking to the full IDBR register. The main disadvantage of using a proprietary API is its “black box” character. Inputs and outputs can be assessed, but ultimately the actual linking algorithms cannot be adapted.

## Linking to the IDBR

Many businesses surveyed in the SBS are not incorporated. Working proprietors and the self-employed will not appear on the Companies House register. To boost the link rate for such businesses and to ensure robustness of links found through the Companies House linking, the Inter-Departmental Business Register was used. The IDBR is a sampling frame including all businesses that are VAT or PAYE registered. This means it excludes many

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Stata code used: *reclink2 companyname entity_type postcode using “data-source”, idmaster(key1) idusing(key2) gen(fuzzyscore) minscore(0.90)*

[6] Instructions on the procedure can be found in video format here: https://vimeo.com/17924204. Further information on the API can be found here: https://api.opencorporates.com/documentation/API-Reference.

small companies, but then includes those unincorporated entities with turnover greater than the VAT threshold or that employ staff.

The IDBR has a live address reference file. It currently holds about 15 million observations providing identification data, including business name and address. Business details are taken from a variety of sources to build as comprehensive a picture of the locations of all UK businesses as possible. Each observation has an associated unique search key (*addressref*) which is linkable to an enterprise or a local unit within an enterprise.

The linking between address identifiers and the IDBR identifiers (*entref*) can change over time as businesses change the locations in which they operate. Also the address file changes as new units are added to the register or as ONS weeds out defunct addresses. Care is taken to avoid deletions due to a change of status. This poses a general problem for the fuzzy linking algorithms, as a business might be dissolved, but then set up again with a very similar name and from the same postcode as the earlier entity. Problems are also apparent in simpler cases of address and name changes. Since the data used for fuzzy linking stores information on all units at all times, but without stating at which year the information was correct, the danger of yielding "outdated" links is high.

The approach taken has sought to follow the method that ONS applied when linking to the IDBR register for SBS 2010, somewhat constrained by documentation being limited[7]. The main difference from linking to Companies House registers is that IDBR linking requires a business type indicator in the linking algorithm (i.e. whether an entity is a working proprietor or a limited company). An example of why this helps is where the registered business is a working proprietor and its primary name in the data is the name of an individual. For these cases, it is often the case that the IDBR holds a trade name as well, which is likely to be the name found in the SBS. As IDBR linking is a heavy data processing procedure, the approach only used the IDBR to link working proprietors from the survey, as well as poor/missing links from previous Companies House linking.

[7] The method described in footnote 4 for Companies House, was also applied to the IDBR linking. The IDBR Address-reference tables were used as the main data source, as it contains company names and tradenames, address and entity-type marker. For linking of sole proprietors, the trading name was used in the linking process, as this was the only information given in the survey.

# 4. Assessing Quality of Linking and Potential Sources of Bias

## Summary

This section reports on three analyses undertaken to assess the quality of the linking, as highlighted on Figure 1. The first focuses on the Companies House linking, where a distance measure has been estimated to qualify a simple fuzzy link on business name. This distance measure was then used to set a threshold of acceptance. All links above this threshold where put through IDBR linking as well, to ensure robustness.

Secondly, clerical linking has been used to understand the main reasons behind failing to link businesses to the IDBR. A sample of the businesses surveyed by SBS that could not be linked was taken. Each were characterised using survey responses and then various business databases were used to check that the businesses could not be linked to a registered business. This systematic clerical linking allows an assessment of the key reasons for being unable to link.

Thirdly, the section reports on analysis of covariates from the survey, to assess potential biases caused by differential link rates. As suggested by the SBS2010 linking exercise, it is expected that smaller, younger and non-incorporated businesses have a lower link rate than more consolidated businesses. However, to fully understand the bias derived from linking, a logit model is constructed explaining the probability of being linked. In selecting variables, this goes beyond the “usual suspects” and includes self-reported ambition for growth, sector and start-up character.

The quality checks were conducted parallel to the linking work, not as a discreet check at the end of the linking. Assessing the quality of the linking at different stages proved an important part of improving the linking strategy.

## Location of Linked Businesses

This subsection considers the quality of the linking to the IDBR. It uses location as a means to check that linking correctly identifies business both by name and location.

For this check, a variable was created for the physical distance between the businesses as recorded in the survey and as recorded in the business register. There are some common reasons for the two addresses/postcodes to be different. For example, a business may register using the address of a service provider (e.g. an accountant), while the survey response may be a place of work. Other reasons include changes of address since the time of the survey, which is expected to be a problem for historical surveys like the ones of interest here. The general logic is that where the physical distance between the survey and register postcode is high, the researcher will have to check that the business has been correctly linked.

The linking algorithms can be used to give some weight to the textual difference in postcodes (e.g. postcode NR2 differs little from NW2) but the textual difference may not correlate with the geographical distance between proposed links and the postcode of the

survey response (Norwich versus London in the example). To calculate this, the postcode reported in the survey entry was compared to that provided by the Companies House register. The longitude and latitude of postcodes, or more precisely the first half of the postcode (outcode), was used to calculate physical distance between the postcodes of the survey entry and the suggested link[8].

The next step was to assess the linked pairs manually, checking the quality of the link. This involved comparing the name, looking at the industrial classification and other business typology data. Manual checks also looked at standard business databases such as Companycheck.co.uk and business websites to corroborate the link. Generally, a fuzzy name link accompanied by a close postcode was found to be a correct link.

Table 3 shows the results of a randomised quality check stratified by the distance between the locations as reported in the survey to that in the IDBR after linking. It is seen that the linking processes flag proposed links as invalid as distance increases. Generally, however, the linking quality is high. The majority of companies are linked to one on the register with the same postal outcode. In this category of "perfect links", all 100 sampled pairs were valid. As the distance increases, so does the rate of false links. A distance from 0-50 km seems to provide a fairly good link, with rates of valid links around 95 per cent. For the 50+ km categories however, this rate drops significantly. When the distance increases to above 100 km, the rate of validity decreases to around 40 per cent. To ensure a good balance between linking quality and quantity, all links with a distance above 50 km was put through IDBR linking as well. In cases where the IDBR linking was unsuccessful, the link was dropped.

**Table 3: Linking validity by distance between linked postcode and postcode from survey data (SBS2006 sample)**

| Distance between survey and IDBR locations | Total number of links in category | Sample size | No. of invalid links | % |
|---|---|---|---|---|
| **0 km** | 2,900 | 100 | 0 | **0%** |
| **0.1 - 2 km** | 78 | 70 | 1 | **1%** |
| **2.1 - 5 km** | 286 | 70 | 3 | **4%** |
| **5.1 - 7 km** | 209 | 70 | 1 | **1%** |
| **7.1 - 10 km** | 254 | 70 | 3 | **4%** |
| **10.1 - 15 km** | 336 | 70 | 3 | **4%** |
| **15.1 - 20 km** | 245 | 70 | 3 | **4%** |
| **20.1 - 50 km** | 562 | 90 | 5 | **6%** |
| **50.1 - 100 km** | 499 | 80 | 21 | **26%** |
| **100 + km** | 1,085 | 80 | 48 | **60%** |
| **N/A (error in distance calculation)** | 128 | - | - | - |
| **Total** | 6,572 | 770 | 88 | **11%** |

The valid +50 km links are usually cases in which a local unit/plant located away from the head office address in the register took part in the survey. This is not a problem per se, but in some cases it is found that surveyed businesses are local units in large multi-national

[8] Distances are calculated by the following formula in MS Excel: 6371*ACOS(COS(RADIANS(90-*lat1*))*COS(RADIANS(90-*lat2*))+SIN(RADIANS(90-*lat1*))*SIN(RADIANS(90 *lat2*))*COS(RADIANS(*long1-long2*)))

enterprises (e.g. a single restaurant in a large chain where the IDBR reports the two being part of the same enterprise) and the survey refers to the local unit. For further use of these datasets, this will have to be made clear. The linking of a survey about a local unit with its parent may mean the data drawn through the link to the IDBR is inappropriate. Employment, turnover and other variables from the IDBR will be about a different entity to the SBS Survey. Section 4 includes a discussion on how to take this into account when using the SBS datasets for analysis.

## Clerical Linking as a Quality Check

To explore the possible explanations behind missing links, this section reports on the clerical linking of a sample of 50 randomly selected unlinked businesses from the SBS2007 survey. By manually searching for businesses on Google, Yellow Pages (Yell.com), Companies House, Companycheck.co.uk and Opencorporates.org, businesses were identified and the cause of the missing link categorised[9]. Table 4 shows the results of this exercise, dividing the different outcomes of the clerical linking into four categories. The 'active' category refers to a survey entry that was identified as an active company through clerical linking. If the fuzzy linking procedure is optimised, it should be possible to link these companies. A common reason for this not occurring is that the business has changed its registered address since the time of the survey. The link on name is then over-ruled because of the change in postcode. This category did however only explain 4% of the missing links in the sample, suggesting that the fuzzy link algorithm is picking up almost all active companies.

**Table 4: Results of clerical linking, by legal status**

| Legal entity | Sole Proprietor | Partnerships | Company | Total | % |
|---|---|---|---|---|---|
| **Active** | 0 | 0 | 2 | **2** | *4%* |
| **Non-Limited** | 27 | 8 | 3 | **38** | *76%* |
| **Not found** | 7 | 2 | 1 | **10** | *20%* |
| **Total** | 34 | 10 | 6 | **50** | *100%* |

Note: Clerical linking attempts were done on the SBS 2007 dataset. The legal status refers to a category from the survey.

The second category is where linking is difficult is where businesses are not limited liability and so would not appear on the Companies House register. Many such businesses would only appear on the IDBR if they were VAT or PAYE registered. As the IDBR, as a consequence, only covers around 50 per cent of businesses, not all sole proprietors can be linked. This is the main reason for non-links, explaining 76 per cent of the cases considered. The businesses do exist in online portals like the Yellow Pages and Companycheck.co.uk, but are not listed on the IDBR register. This is most likely explained by lack of either VAT or PAYE registration. It is also apparent that some surveyed businesses have not been aware of their own legal status, as three of the six respondents claiming to be companies are listed as non-incorporated businesses online.

Lastly, there are businesses that proved impossible to find. These businesses did not appear in the online registers, and did not return anything when using standard search

[9] The clerical linking process included using full addresses from the SBS identification data, along with different permutations of name and postcode.

engines for all combinations of postcode and business name. In six of the 50 cases the business name in the survey is the name of a person, which makes identification harder. These “under-the-radar” businesses are not expected to be available for any sort of analysis, unless they enter the VAT or PAYE system in future years. This group accounts for 20 per cent of the non-linked businesses.

## Potential bias: Linking Rates and Business Characteristics

Table 5 combines the link rates observed with responses in the SBS about business characteristics. The table shows results for SBS2006, SBS2007 and SBS2010. Numbers indicate that the characteristics of successfully linked businesses across the three waves of the SBS differ.

The SBS is focused on smaller businesses. Micro businesses (1-9 employees) or those that have no employees are generally harder to link, reflecting the lower likelihood of small businesses appearing on the Companies House, VAT or PAYE registers. Medium sized businesses – of 50-250 employees – have a high rate of linking success. In comparison with the linking to SBS2010, SBS2006 and SBS 2007 linking is more successful for medium sized businesses. Whereas only 77 per cent of medium sized businesses were linked in SBS2010, the corresponding figure is 88 per cent for the SBS2006 and 2007. For micro-businesses, the SBS2010 has been linked better, but this is the only size band where this is the case.

### Table 5: Link rates compared across SBS waves, by business size

| | SBS2006 | | SBS2007 | | SBS2010 | |
|---|---|---|---|---|---|---|
| | Link rate | Total count | Link rate | Total count | Link rate | Total count |
| No employees | 56% | 812 | 53% | 1,312 | 51% | 627 |
| Micros (1-9) | 71% | 3,223 | 68% | 3,002 | 75% | 1,308 |
| Small (10-49) | 83% | 3,231 | 83% | 2,590 | 80% | 1,333 |
| Medium (50-249) | 88% | 1,374 | 88% | 1,081 | 77% | 678 |
| Total | 77% | 8,640 | 73% | 7,985 | 73% | 3,946 |

Note: The numbers refer to values from the survey.

Table 6 indicates that companies, defined to include the range of limited liability entities, have a far higher link rate than other entity types. Across all three surveys private limited companies and other limited liability entities are overrepresented in the linked dataset. The linking undertaken of SBS2006 and 2007 yields around 90 per cent link rates for this group. Looking at the markedly lower link rates for sole proprietors, a source of potential bias from the linking is clear.

### Table 6: Link rates compared across SBS waves, by legal status

| | SBS2006 | | SBS2007 | | SBS2010 | |
|---|---|---|---|---|---|---|
| | Link rate | Total Count | Link rate | Total Count | Link rate | Total Count |
| **Sole proprietor** | 58% | 1,625 | 49% | 1,965 | 52% | 715 |
| **Partnership** | 53% | 1,464 | 52% | 1,305 | 67% | 462 |
| **Companies** | 90% | 5,535 | 89% | 4,715 | 78% | 2,764 |
| **Don’t know** | 81% | 16 | . | . | 64% | 33 |
| **Total** | 77% | 8,640 | 73% | 7,985 | 72% | 3,974 |

Note: The legal status refers to a category from the survey.

VAT registration is also a strong explanation behind linking success. Across all surveyed businesses, VAT-registered respondents have a link rate of around 80 per cent, whereas

this is around 50 per cent for non-registered ones. Looking at sole proprietors only, VAT registration increases the link rates by about 20 percentage points from 39 to 59 per cent.

Table 7 shows the result of a multivariate logistic regression, highlighting which variables influence the probability of being linked to the IDBR. The dependent variable is the binary link status. Apart from the variables examined above, both sector and age is found to influence the probability of being linked to the IDBR. Legal form, number of employees and VAT registration do however remain the most influential determinants of linking. A registered company has over five times higher odds than sole proprietors of being linked to the IDBR controlling for all other characteristics.

The logit model underscores that being successfully linked is not random, which in turn renders the survey weights of less use for analysts using the datasets. New weights, taking into account the linking bias, will have to be constructed to get a representative sample of businesses. The logit models shows similar patterns across both survey waves, suggesting that any linking bias is consistent.

**Table 6: Determinants of businesses being successfully linked to the IDBR**

| Dependent variable is IDBR link status (0/1). Successful link = 1 | SBS 2006 | | SBS 2007 | |
|---|---|---|---|---|
| | **OR (exp β)** | **s.e.** | **OR (exp β)** | **s.e.** |
| Employees | 1.004*** | 0.001 | 1.004*** | 0.001 |
| *Sector (A Agriculture, hunting etc.)* | | | | |
| B Fishing | 1.057 | 1.271 | 2.225 | 1.233 |
| C Mining and quarry | 2.01 | 1.053 | 1.085 | 0.742 |
| D Manufacturing | 1.946*** | 0.158 | 2.258*** | 0.171 |
| E Electricity, gas etc. | 0.45 | 0.695 | 2.948 | 0.864 |
| F Construction | 1.886*** | 0.173 | 1.975*** | 0.176 |
| G Wholesale and retail | 1.490*** | 0.147 | 1.826*** | 0.156 |
| H Hotels and restaurants | 1.804*** | 0.161 | 1.964*** | 0.171 |
| I Transport, storage | 1.369* | 0.176 | 1.926*** | 0.194 |
| J Financial intermediation | 2.114*** | 0.267 | 1.748** | 0.258 |
| K Real estate etc. | 1.481** | 0.156 | 1.813*** | 0.16 |
| L Public administration | 0.734 | 0.512 | (empty) | |
| M Education | 1.447 | 0.416 | 3.262*** | 0.404 |
| N Health and social | 1.171 | 0.261 | 1.361 | 0.222 |
| O Other community | 1.096 | 0.197 | 1.653*** | 0.184 |
| Age | 1.023 | 0.026 | 1.050** | 0.02 |
| Legal form (Sole Prop.) | | | | |
| Partnerships | 0.742*** | 0.076 | 0.847** | 0.077 |
| Companies | 5.139*** | 0.074 | 5.817*** | 0.073 |
| Start-up (No) | 1.071 | 0.172 | 0.943 | 0.095 |
| VAT registration (Yes) | | | | |
| No | 0.451*** | 0.09 | 0.458*** | 0.079 |
| Unwilling to say | 0.573 | 0.779 | 0.751 | 0.795 |
| Growth ambition (Will grow) | 1.005 | 0.063 | 0.866** | 0.063 |
| Constant | 0.654 | 0.697 | 0.569** | 0.233 |
| Pseudo-$R^2$ | 0.17 | | 0.18 | |
| Log likelihood | -3907 | | -3796 | |
| N | 8,640 | | 7,976 | |

Note: Table shows odds ratios from logistic regression. Reference categories in parenthesis. All the variables used are from the survey.

# 5. Analysing the Reliability of SBS Self-reported Values

## Summary

This section reports analysis about how reliable the self-reported survey responses are in comparison with equivalent estimates derived from the linked administrative data. It looks at any differences between self-reported and IDBR measures of employment. Similar comparative analyses are undertaken for turnover.

The results indicate values are generally similar between the two sources, but they also identify differences that arise due to comparability problems. Firstly, differences could arise due to false links. The checks on the quality of the linking suggest this would not provide a complete explanation. Secondly, differences could indicate that survey responses are incorrect, or that administrative data is incorrect. There is some evidence that it is more likely to be the former. A third possible explanation is that the linking is correct at entity level but that the survey response is with respect to a different part of the entity than the record found in administrative data. This is most likely to occur in complex business structures. A survey respondent may be answering about a particular plant or local unit, not covering the entirety of the business that is the focus of the ONS Business Structures Database that is used here.

A final area considered in this section is the source for IDBR employment numbers. IDBR uses a variety of sources and, for any business, will use that source which is believed to be most reliable at the time. Many businesses have employment estimates based on snapshots of the PAYE system. This is over-ridden with estimates from surveys where a business has fallen within the sample of one of the ONS employment surveys. The complexity of sources result in an issue of timing: if a survey respondent estimates employment at a particular time, there will be a lag as a record of employment enters the different administrative systems or is requested through an ONS survey.

## Comparing BSD Employment Estimates with Linked Survey Responses

Below are two scatterplots, comparing the employment value reported in the survey (y-axis) with the employment value in the ONS Business Structures Database (BSD, on the x-axis). Similar comparative analyses are undertaken for turnover[10]. The BSD is an annual snapshot of the IDBR that is then archived so that there is longitudinal register information about business employment and turnover. The BSD replicates the structure of the IDBR,

[10] See Annex B Table B7 (sub tables 5-8) for a comparison of expected/reported turnover growth and Table B9 for results of a simple comparison between survey and BSD turnover size bands. The turnover variable held in the SBS survey is ordinal-scaled, meaning that a lot of the analyses undertaken for the analysis of employment is not feasible for turnover. The analyses undertaken suggest that the patterns seen for the employment variable are seen for turnover as well. Judging by the chi-squared test values of the two analyses, survey turnover seems to be slightly better correlated with BSD turnover, compared with employment numbers.

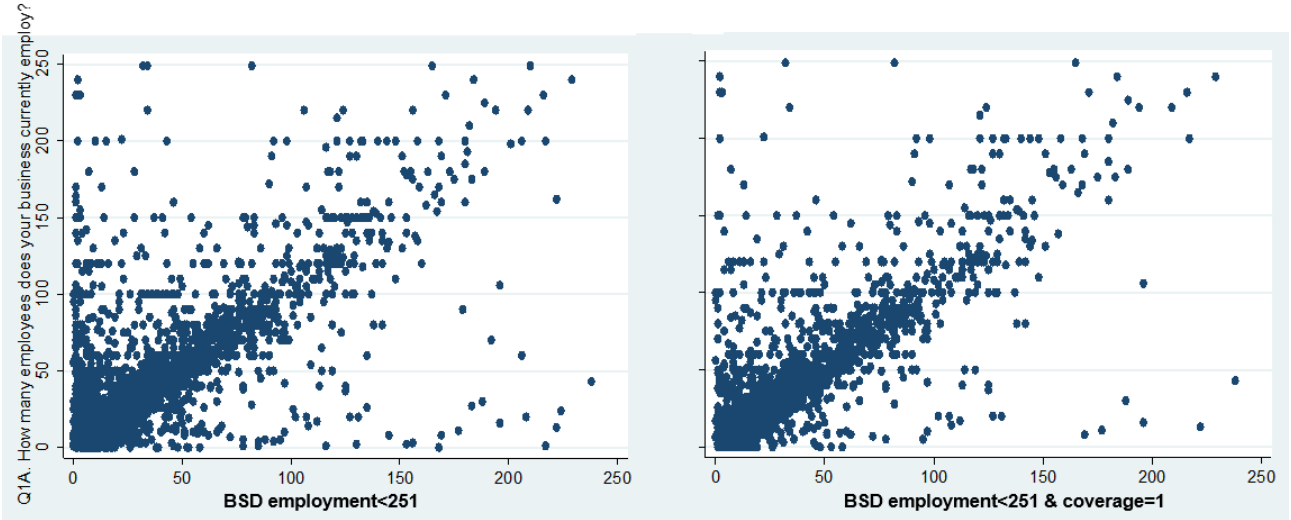
compiling data for enterprises and the associated local units. However, it also then links over time allowing analysis of turnover and employment time-series at a firm level.

The plots exclude businesses larger in size than 250 employees. A similar plot for all businesses in the SBS would highlight, potentially in a disclosive manner, how quite a few surveyed units form part of very large enterprises. One of the main problems with the linking of a survey to an administrative dataset is that the survey may only refer to that part of a large business where the respondent is based. This leads to extreme outliers in the plot, as local unit survey values differ significantly from those found at the enterprise level. In these outliers, there is no evidence that linking has been of a poor quality; rather it is clear that the SBS is focusing on a single local unit of the large multi-plant enterprise.

The left-hand side scatter plot focuses on the distribution of businesses that falls within the definition of a SME (i.e. equal to or below 250 employees in the BSD). The plot on the right-hand side builds on this, by introducing a qualifier based on survey coverage. The SBS asks the respondent how many units are present in the business being surveyed. Comparing this with the number of local units reported in the BSD offers an insight into whether businesses are responding about a different set of units to those the BSD enterprise covers. Complete coverage is where the survey respondent identifies the same number of local units as in the BSD. The right-hand panel is therefore focusing on responses where there is confidence that the SBS and IDBR data is covering the same portion of a business.

On both plots, a concentration around the 45-degree line indicates a strong correlation between survey responses and BSD data. However, the spread around this 45-degree line is rather large and it is obvious that the correlation is not perfect. Correlation improves in the second panel where coverage by the respondent is the same as that in the IDBR. This is where the respondent's view on the number of local units or plants, collected in a specific survey question, is the same as that in the administrative data.

**Figure 2: Correlation between survey employment and BSD employment**




Note: The scatterplots contain data from the SBS2007. The BSD 2008 employment values are used as a comparison.

An observation regarding the overall quality of the survey is the high number of responses that report employment at rounded numbers, such as 50 or 100 or 150. This centring of data is likely to reflect respondents making educated guesses regarding employment

numbers. It is likely that there will then be a number of employment estimates in the survey that are imprecise. This is likely to permeate other responses to the survey questions.

The plots suggest some simple heuristics for users of the linked data to ensure that analysis focuses on businesses where data is robust. One rule would be to remove linked businesses above 250 employees in the BSD. Table 7 uses this rule, removing businesses that may not be regarded as an SME when using the BSD employment data. The removed businesses are mainly multi-plant in the IDBR, making them too large to be included in the survey if ONS organisational structures are used to define firm size. The BSD employment distributions in Table 7 are more consistent with the SBS employment numbers than if such businesses are included.

**Table 7: Comparison of employment values, by survey business size bands**

| | SBS 2006 | | | SBS 2007 | | | SBS 2010 | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **Median** | **N** | **Mean** | **Median** | **N** | **Mean** | **Median** | **N** |
| None | 2.8 | 2 | 384 | 3.2 | 2 | 572 | 2.2 | 1 | 279 |
| 1-9 Micro | 5.9 | 4 | 1,994 | 5.8 | 4 | 1,807 | 5.6 | 4 | 926 |
| 10-49 Small | 19.4 | 16 | 2,486 | 19.5 | 15 | 2,016 | 21.5 | 18 | 1,012 |
| 50-250 Medium | 71.7 | 65 | 1,124 | 68.5 | 62 | 870 | 80.7 | 72 | 492 |
| Total | 23.2 | 11 | 5,988 | 21.1 | 9 | 5,265 | 24.8 | 11 | 2,709 |

Note: This calculation only includes businesses with employment<251 in the year following the survey in the BSD (i.e. for SBS 2006, BSD 2007 employment values are used). Without the threshold rule, mean employment values for the SBS2010 were the following: 'None': 193, 'Micro': 433, 'Small': 128, 'Medium': 181. Medians remains almost unchanged. Similar inconsistencies are found for the SBS2006 and 2007.

The survey categorises the businesses into the four size bands listed on the left-hand side and there is a consistency between the mean and median. The one exception is the category of businesses with no employees, where the BSD seems to report a consistently higher number of employees.

As the plots in Figure 2 show, the coverage variable also helps to increase the correlation between estimates from the survey and administrative data. Table 8 supports this by highlighting how the differences between survey employment and coverage is highly correlated. Where the coverage is low (e.g. a case where the survey response relates to one unit, and the enterprise link has a hundred local units), BSD reports a lot higher employment than the survey. This issue appears to be significantly ameliorated as coverage increases, and employment values seem to converge in cases of 100 per cent coverage. About three-quarters of the SBS responses that were linked are in this category.

**Table 8: Coverage and differences in employment between SBS and BSD**

| Coverage | Mean | 50th per centile | 75th per centile | Std. Dev. | Count |
|---|---|---|---|---|---|
| 0 – 25 % | -58,135 | -3,410 | -226 | 84,167 | 143 |
| 25.1 – 50 % | -20 | -3 | 1 | 79 | 188 |
| 50.1 – 75 % | -40 | 0 | 10 | 294 | 53 |
| 75.1 – 99 % | -1 | 3 | 13 | 30 | 37 |
| **99.1-100.1 %** | **0** | **0** | **3** | **27** | **3,092** |
| Above 100.2 % | 12 | 7 | 24 | 110 | 752 |
| Total | -1,948 | 0 | 5 | 18,586 | 4,265 |

Note: For SBS2006. The difference is calculated as (SBS2006 employment) – (BSD employment 2007). See Annex B2 for SBS2007 table.

The numbers do however suggest that coverage from 25 to 100 per cent provides a fairly good link in terms of employment figures. The medians for the differences between the survey response and the linked BSD entities are all around zero, whereas the 75$^{th}$ per centile is no higher than 13. In cases of 100 per cent coverage, both median and mean are zero.

Coverage is only an issue in cases where the linked business has multiple plants. The analysis has therefore then linked the survey responses for multi-plant businesses to the BSD local unit data for the respondent's plant. In most cases, employment reported in the SBS is closer to the local unit that shares the same postcode as the surveyed firm. This suggests that the respondent may be estimating employment only for the local unit they are based in. The average difference is halved when using local unit employment, linked either through the full postcode or the postal outcode. This confirms the hypothesis that the large employment differences are not caused by false links, but by enterprise unit administrative data being linked to local unit survey data.

The main consideration when applying the different threshold rules is the number of observations remaining for analysis. Using the two rules separately, and when using them in combination, leaves a reasonable number of survey respondents available for analysis. Applying the employment rule leaves more than 95 per cent of businesses for analysis (this number will vary from year to year and between surveys). Applying both the employment and the coverage threshold rule simultaneously will leave roughly 50 per cent of businesses. Depending on how sure analysts want to be that the survey response relates to the same unit of measurement as linked in the BSD, these rules can be used flexibly.

## Influence of BSD Time Lags

Cross-sectional analysis of a survey faces a simultaneity problem. Analysis will examine the effect of particular capabilities on growth that occurs at the same time or shortly after the capability measures are taken. The main rationale behind linking survey responses to administrative data sources is that it allows analysts to construct longitudinal data and to assess the drivers of long-term outcomes. An issue with linking a survey response to administrative data then becomes the timing of the survey in relation to the longitudinal data.

The point in time to which a particular employment estimate in BSD data refers is complex because of the range of data sources used in estimation. The BSD employment numbers in the 2007 dataset, published in December, will be taken from the IDBR in March 2007. The IDBR estimates are based on actual employment numbers at a variety of points in time, but the most common would be September 2006. This is the point in time on which a number of key data sources will centre. For example, the PAYE based estimates in March 2007 will average payroll numbers over the previous twelve months; a similar averaging will occur on turnover data derived from VAT returns.

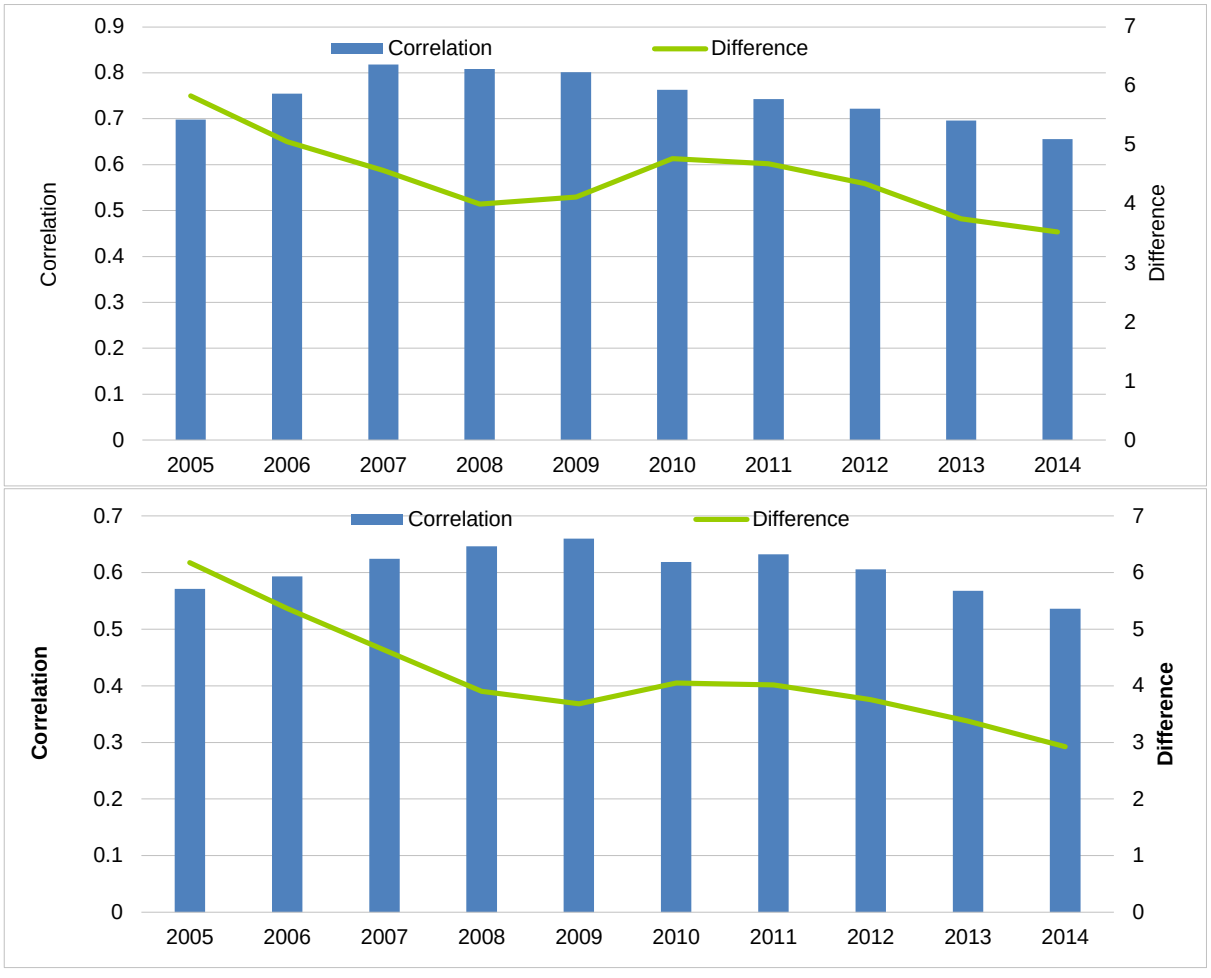
There is a further complexity due to the preference for ONS survey estimates over administrative sources, even where the administrative data is more recent. In 2006-8, the period of the two SBS waves, the ONS surveys that routinely collected employment were the annual Business Register Survey in September, Annual Business Inquiry and monthly/ quarterly short-term employment surveys. Because ONS regards surveys as more

accurate and is reluctant to use lower quality payroll data, for some businesses surveyed by BRS the IDBR will retain the same employment estimate for up to four years even though updated payroll information is available from PAYE.

The Small Business Surveys for 2006 and 2007 were both conducted from November to March, crossing over two calendar years. Therefore, the expectation is that the survey numbers for a particular year will have high correlation with two years of the BSD: that for the following year and the year after. So SBS 2006 would have concluded in March 2007 and employment estimates in BSD 2007 or 2008 could present a comparable measure.

Figure 3 shows the differences in average employment between the point in time estimate from the survey and the different updates of the linked BSD. It also looks at the correlation between the employment estimate in a survey and the BSD at firm level. The graphs focus on businesses with employment of 250 or less, meaning that the total number of businesses is around 6000 for the SBS2006 and 5200 for the SBS2007. The total number of businesses changes from year to year as some businesses enter and exit the pool over time.

**Figure 3: Employment comparisons between SBS and BSD over time**[11]




[11] See Figure B2 in Annex for boxplots, and differences between applying the two threshold rules.

Note: The top graph contains information about the SBS2006, while the lower is for SBS2007. X-axis refers to different BSD years. Threshold rule applied: 250 employees or less.

The picture is largely similar across the two surveys. The average survey employment is consistently higher than the BSD employment. (This would not be the case if large businesses were included.) A possible explanation for this is that the survey asks for the total number of full and part time employees (including temporaries/casuals if directly employed, but not agency staff). The BSD, on the other hand, is counting the number of full time employees (see Sova et al., 2013).

The graphs also show how the average difference decreases, before then increasing again. Similarly, correlation increases and decreases. For both SBS2006 and 2007, it seems that the minimum average difference is found in the BSD for the survey year plus two years. For the SBS2006, the minimum difference is four employees on average in BSD 2008. For SBS2007 this is four in BSD 2009. With regard to correlation, this peaks at 2007 and 2009 respectively. This is consistent with expectations that the BSD will pick up the employment reported in the survey with a lag of one to two years.

## Influence of BSD Employment Source

The BSD contains two variables that indicate whether the administrative data within the IDBR is derived from PAYE and/or VAT data. The ONS documentation suggests that combining these measures provides a quality measure within the IDBR, where good quality results from estimates being derived from both PAYE and the VAT register. In these instances, the ONS is confident that the administrative information is sourced robustly.

Looking only at surveyed businesses with BSD employment of 250 or less and 100 per cent coverage, it seems as if the VAT and PAYE quality markers influence the validity of employment estimates in the BSD quite markedly. About 5 per cent of linked businesses are not registered for PAYE. In these businesses the percentage difference between survey employment and register employment is very high, at 240%. Where the business is registered for PAYE, this difference drops to 30%.

Table 9 also indicates the difference in employment when businesses are registered for VAT. BSD employment is, on average, higher than that seen in the survey for these businesses.

**Table 9: Source of BSD information and influence on employment differences.**

| Source | | VAT | | PAYE | | VAT and PAYE | |
|---|---|---|---|---|---|---|---|
| | | **Diff. (levels)** | **Diff. (%)** | **Diff. (levels)** | **Diff. (%)** | **Diff. (levels)** | **Diff. (%)** |
| **Not registered** | Mean | -1.4 | 40 | 1.7 | 240 | 0.6 | 80 |
| | Median | 0 | 0 | -1 | -50 | -1.0 | 0 |
| | N | 139 | 138 | 97 | 96 | 394 | 393 |
| **Registered** | Mean | 1 | 30 | 0.9 | 30 | 1.0 | 30 |
| | Median | 0 | 0 | 0 | 0 | 0 | 0 |
| | N | 2,880 | 2,880 | 2,864 | 2,864 | 2,691 | 2,691 |
| **Total** | Mean | 0.9 | 30 | 1 | 30 | 1 | 30 |
| | Median | 0 | 0 | 0 | 0 | 0 | 0 |
| | N | 3,019 | 3,018 | 2,961 | 2,960 | 3,085 | 3,084 |

Note: For SBS2006. The difference is calculated as (SBS2006 employment) – (BSD employment 2007) for levels, and the equivalent for percentages. See Annex B3 for SBS2007 table. Threshold rule applied: both <251 employees and coverage is 100 per cent.

## Business Expectations to Growth

In assessing the reliability of survey responses, a strand of analysis centres on businesses' ability to foresee their future growth trajectory (as well as correctly state their previous growth). Figure 4 shows a simple analysis comparing businesses survey response on expectations to future employment growth to employment growth observed in the BSD. Across the two survey waves, businesses were asked the following two questions about growth trajectories:

> *Q11. You said earlier that your business currently employs [INSERT Q1A RESPONSE] people, excluding owners and partners. How many people did the business employ 12 months ago across all sites?*
> *Q17. How many people do you expect the business to employ in twelve months time?*

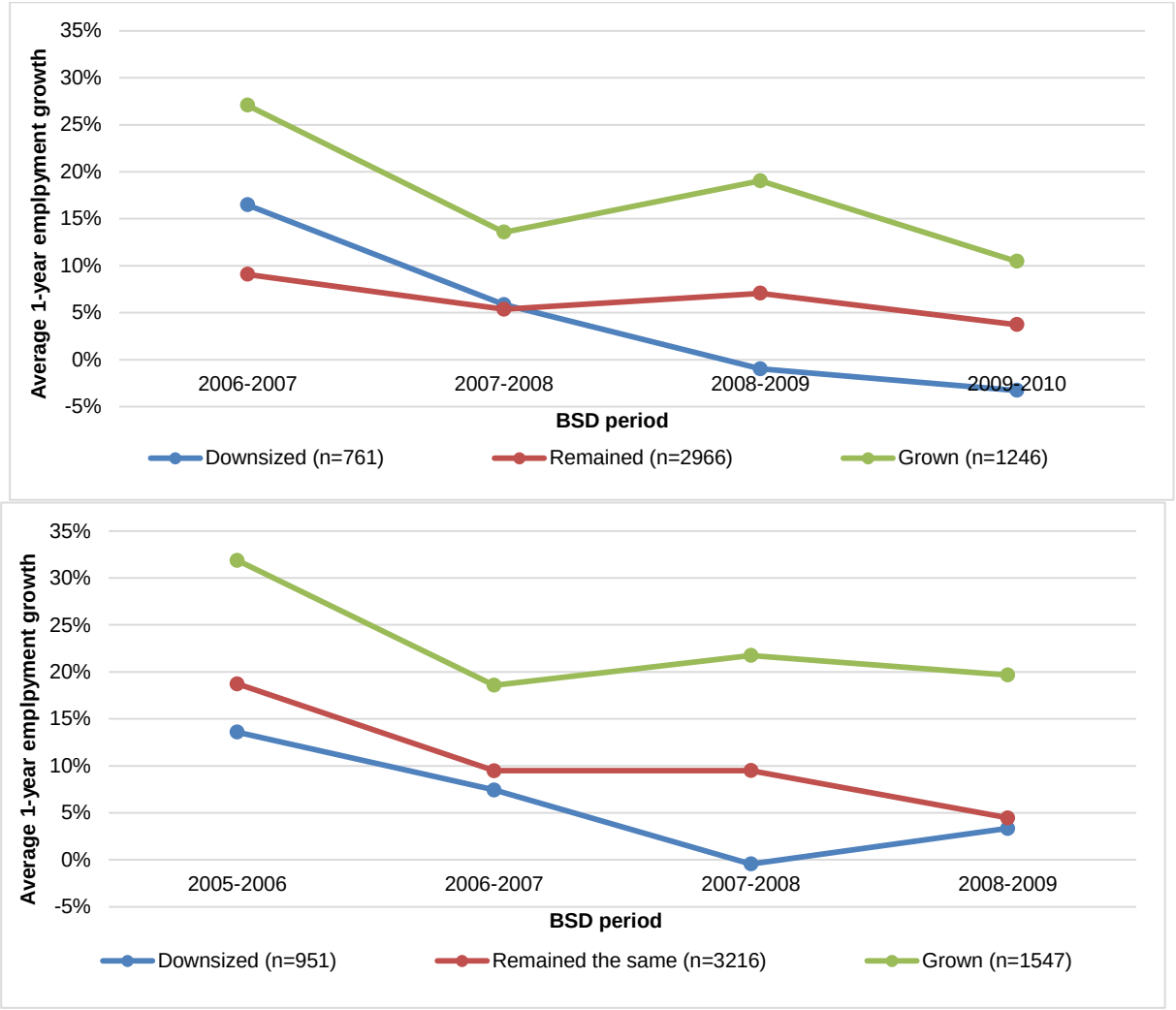
From the response to these questions, businesses were divided into three groups[12]: those experienced/expecting positive growth, those experienced/expecting negative growth and those with no growth. SBS asks for employment numbers, but using these to calculate a numeric change proves hard, as it is not clear if all survey responses are coded consistently. In many cases, it seems as if the survey has recorded the marginal employment change rather than the expected number of employees one year later (i.e. a 100-employee business expecting to employ 108 one year later has the value 8).

Figure 4 and 5 look at two areas: one is the reliability of businesses' responses about their growth trajectory and the other is the timing of the BSD. From the analysis on timing earlier, it is expected that pre-survey growth relates to growth from 2007-2008 for SBS2006 and 2008-2009 for SBS2007. It should be noted that the analysis only looks at continuing firms, thus not accounting for differential survival rates among the different categories of businesses. This also means that the number of observations is different from year to year. The counts in the actual graphs refer to the number of businesses in the middle year. Business survival will be investigated further in the next section.

Figure 4 looks at past growth, showing the year-on-year average employment growth for the three groups of businesses. The results suggest that there is some degree of consistency between surveyed growth trajectory and the information held in the BSD. Businesses stating that they have downsized in the 12 months prior to the survey have the lowest average employment growth of the three groups. The 'downsize' group from the SBS2006 only touches the boundary for negative growth in the 2007-2008 BSD window. For the group in SBS2007, BSD shows negative employment growth from 2008-2009 and 2009-2010 as expected based on the survey response. The two remaining groups both show positive growth across the period. Those stating that they experienced growth are seen to have higher average growth rates.

[12] Only very few businesses answered "Don't know" (between 10 and 60 across both surveys and questions). These are excluded from the analysis.

**Figure 4: One-year BSD employment growth by surveyed responses**

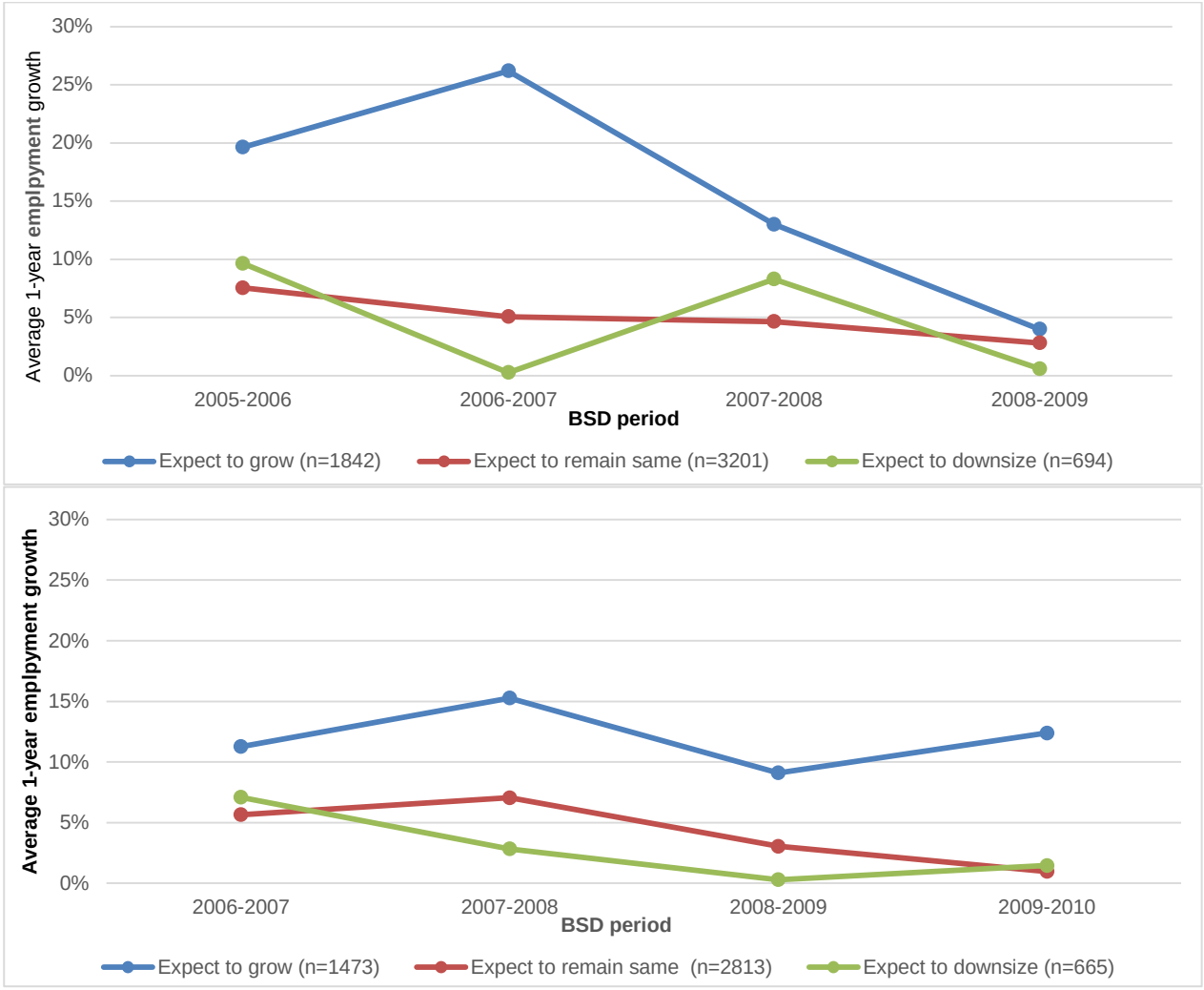



Note: 1-year developments in employment, in percentage. The top graph contains information about the SBS2006, while the lower is for SBS2007. Threshold rule of employment<251 is applied.

Figure 5 looks at expectations to future growth among the surveyed businesses. From the analysis on timing earlier, it is expected that post-survey growth relates to growth from 2008-2009 for SBS2006 and 2009-2010 for SBS2007. The conclusions here are fairly similar to the ones above. Businesses seem capable of foreseeing future growth accurately. Businesses expecting growth did experience higher growth than the remaining businesses. For the two remaining groups, the actual growth seems to be higher than the expected across both survey waves.

The graphs also highlight the general development in the SME environment across the period. The average one-year growth rate from 2006-2007 for the entire SBS2006 was 12%, going down to 3% in 2009-2010 (in 1-2 year lagged BSD time). For the SBS2007 population, the growth rate halved from 7.5% in 2007-2008 to 4% in 2010-2011. Considering the lagged nature of the BSD, these numbers seem to correspond to the timing of the financial crisis and its effect on SMEs.

**Figure 5: One-year BSD employment growth by surveyed expectations**




Note: 1-year developments in employment, in percentage. The top graph contains information about the SBS2006, while the lower is for SBS2007. Threshold rule of employment<251 is applied.

Table B7 in Annex B tabulates actual and expected values along with a chi-squared measure of association. The four tables suggest that there is a correlation between survey responses and a similar categorisation constructed on the basis of administrative data (i.e. businesses stating that they downsized in the survey, appear to have downsized more frequently in the administrative data). Survey responses to the question about prior growth are correlated with growth in the BSD, and respondents that expected future growth are likely to realise that growth in the BSD data. The relationship for prior growth is considerably stronger than the one found for future growth.

For the comparison of prior growth, the results suggest that the association for the SBS2006 is strongest in the 2007-2008 BSD window and in the 2008-2009 window for the SBS2007. This is illustrated by large increases in chi-squared values. This confirms earlier findings of the BSD timing. Interestingly, similar timing patterns are found for comparison between expectations to future growth and realised growth in the BSD (i.e. the strongest correlations are found in the same years as the analysis on prior growth). This finding

suggests, somewhat unsurprisingly, that growth in the 12 months prior to the survey is correlated with expectations to growth in the 12 months following the survey.

# 6. Dynamics of Small and Medium Enterprises: 2006-2013

## Summary

This section looks at the performance of the businesses that responded to the 2006 and 2007 waves of the SBS. It covers the period after the survey to 2013, including the impacts of the recession in 2008. Firstly, the linking to the IDBR is used to analyse whether the businesses survive. This uses the ONS Business Structures Database. In the second section, some of the questions in the SBS are used to analyse the drivers for business survival.

This brief analysis illustrates the benefits of using longitudinal data, made possible by the data-linking exercise. The effect on survival and growth of drivers such as innovation or investment in training is difficult to identify using cross-sectional data in which indicators are contemporaneous. The effect of innovation on performance is perhaps the best example of this problem, as any performance impacts can take many years to become evident. The preliminary analysis conducted here, however, illustrates that the effect of such factors can now be assessed using the linked data. This lays the foundations for subsequent, more detailed analyses.

## Demographic Change in Businesses Responding to SBS 2006 and 2007

The dotted lines in Figure 6 records the percentage of enterprises where the linking provided businesses linked to a live ONS enterprise for each of the years from 2005 to 2014. The data used for this is the ONS Business Structures Database, which includes from its snapshots of the IDBR each year a variable indicating whether the enterprise is live during the year. Research has indicated the robustness of this measure; it is not simply a business dropping out of the BSD (Anyadike-Danes et al., 2010). Rather, a range of measures recorded in various administrative systems is used to prove whether a business is alive. For example, ONS is regularly informed about whether businesses are maintaining a PAYE system and have employees.

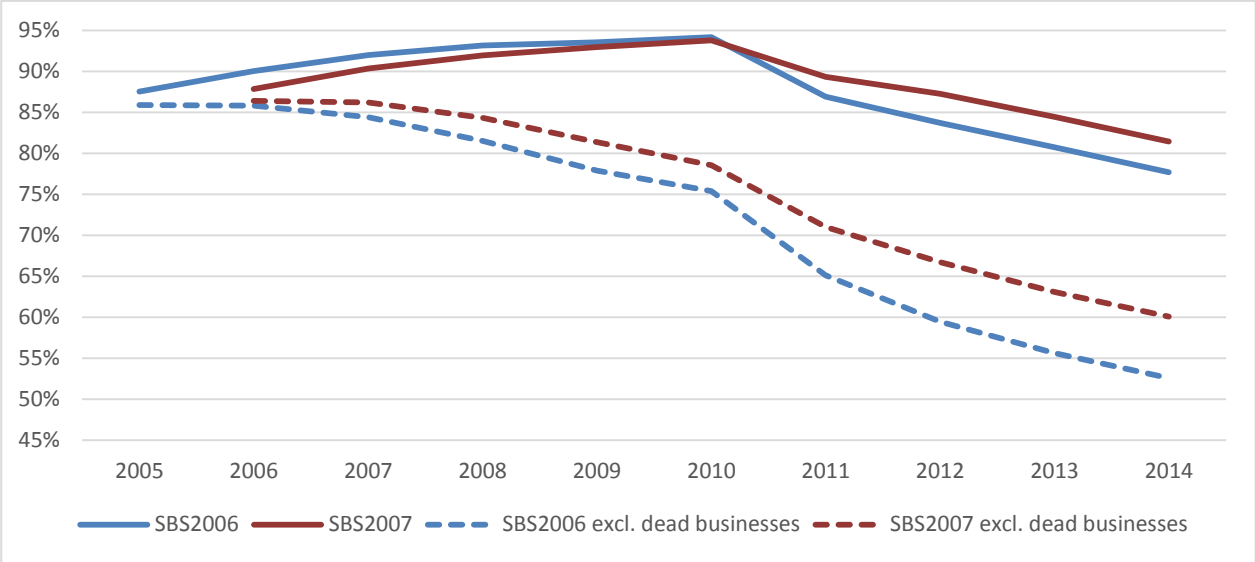
This measure is qualified by constructing a death year variable for all successfully linked businesses, which includes both business activity measures (turnover) and the death variable created by ONS in the BSD (ONS variable “death”). The solid lines on Figure 6 show how this alters rates, when including companies whose turnover/employment was zero in the BSD, and companies that were pronounced dead by ONS.

Figure 6 indicates a gradual rise in the number of surveyed businesses that appear on the register until 2010. This reflects some of the businesses being too small to appear on the IDBR at the time of the surveys, but then appearing on the register as they grow. For the 2006 survey, 88 per cent of businesses surveyed are found on the BSD in 2005; this rises to 94 per cent by 2010. Considering the constructed death variable, the number of “live” businesses is lower yet, around 90 per cent for both surveys in 2010.

The fall in business numbers after 2010 is quite marked. The recession reduced the number of businesses found on BSD to 78 per cent for SBS 2006 and 81 per cent for SBS 2007. This means a loss of about 1000 businesses surveyed in SBS 2006. During the same period, about 700 businesses that were surveyed in 2007 are also lost from the register. The percentage of businesses that die across the period is significantly higher, as the graph shows (1,455 dies of the SBS 2006 survey and 1,086 dies from the SBS 2007 survey).

As found in other studies of business demography, there is churn in the businesses that are on the register. For both waves of the survey, many businesses appear in the register, then have a spell of business activity, before disappearing. This is investigated further later in this Section.

**Figure 6: Enterprises with 'entref' linked to yearly BSD datasets over time**




## Analysis of Firm Survival and Employment Growth

An examination of the determinants of firm survival and growth to 2014 illustrates the type of longitudinal analysis that can be undertaken as a result of linking the SBS with the BSD. It extends beyond recent studies such as Lee (2011). For the survival analysis two dichotomous dependent variables were created representing firms which responded to the SBS2006 and survived through, firstly, the crisis (till 2011) and, secondly, through to the end of the panel in 2014.

For the analysis of firm growth, results from a probit regression and an OLS regression model are presented. These respond to the problem of relative growth rates in two different ways. Using growth rates will inevitably result in smaller firms appearing to grow faster. If a firm has one employee and then takes on a second over the period examined, its firm size increases by 100%. By contrast, if a firm has 100 employees at the beginning of the period and it takes on a single additional employee over the period to 2014, its firm size increases by 1%.

For the probit analysis, the group of surviving firms were dichotomised into those exhibiting above-average employment growth over 2007-2014, and those exhibiting below-average

employment growth over 2007-2014. The mean employment growth for firms surviving the whole period 2007-2014 is 42%. However, it should be born in mind that this is also partly a feature of the way in which growth is calculated and due to the high proportion of micro firms in the sample. To accommodate for this size effect, squared baseline employment has been included in the probit model as an explanatory variable. Similarly, in the OLS regression, the growth rate is calculated from logged employment and employment in second and third power are included as explanatory variables. This should give unbiased parameter estimates for the remaining variables in the model.

Many of the explanatory variables in the analysis are also binary, dummy variables. This makes the interpretation of results more intuitive (i.e. producing a single average marginal effect for each variable) and – because of the range of SBS questions covered – gives more explanatory options. The definition of each dummy variable in terms of the SBS questions used is given in Table B5 in Annex B.

### *Determinants of Survival*

Table 10 shows the average marginal effects for particular determinants of firm survival from 2007-2014, and through the financial crisis till 2011. Both probit models are reported to assess whether survival through the crisis are determined by different factors than survival generally. No major differences are observed, except with regards to the marginal effects of training of personnel and management. Other than this, most effects are similar, albeit stronger and more significant when looking across the whole period.

Overall, of the 5,317 firms, 4,226 survive to 2014. Firms that were of a larger size in 2007 were more likely to survive to 2014. A one-unit increase in firm size, calculated as the log of employment, has a positive average marginal effect on the likelihood of survival to 2014 of 2.3%, and is highly statistically significant. Similarly, firm age affects survival, with each additional year of business operating increasing the likelihood of surviving to 2014 by approximately 0.5%, statistically significant at the 1% level.

Interestingly, seeking business advice is associated with an approximately 3% *decrease* in the likelihood of survival. This perhaps makes more intuitive sense than it first appears since firm owners and managers may be more likely to seek advice if they do not consider the firm to be performing adequately, or if they think it is in danger of failure. Investment in training has a strong positive effect on the likelihood of survival, boosting it by a statistically-significant 3%. Product innovation affects likelihood of survival over the long term. Firms introducing a new product in the twelve months prior to 2007 see an increase in their likelihood of survival to 2014 of approximately 2.5% above that of the base category of firms that did not introduce a product innovation. Process innovation on the other hand, is not associated with increased survival rates.

Other significant determinants of firm survival derived from the survey include future ambitions and expectations of closure/full transfer of ownership in the near future[13]. The latter is self-explanatory, but the former is an often-unobserved variable that leads to biased conclusions when omitted from analyses on business growth. The analysis suggests that firms are able predict future outcomes to some extent. An even stronger

[13] Q161: “Do you anticipate the closure, or a full transfer of the ownership of your business in the next 5 years?”

driver for survival is access to finance. Businesses were asked whether they had been seeking finance in the year leading up to the survey, and about the ease of this process. The model suggests that having problems in seeking finance decreased the likelihood of survival through the whole period by 8.2 per cent (5.1 per cent through the financial crisis) compared to firms not seeking any finance.

### Table 10: Determinants of firm survival from 2007-14 and 2007-2011

| | Panel-survival (07-14) | | Crisis survival (07-11) | |
|---|---|---|---|---|
| | **Marginal effect (β)** | **s.e.** | **Marginal effect (β)** | **s.e.** |
| **Determinants, marginal effect** | | | | |
| Firm size (ln) | 0.023*** | 0.005 | 0.018*** | 0.004 |
| Age | 0.005*** | 0.001 | 0.003*** | 0.001 |
| Expectation for future employment (Grow) | | | | |
| Same | -0.009 | 0.012 | 0.001 | 0.010 |
| Less than | -0.039** | 0.018 | -0.017 | 0.015 |
| Anticipate closure/transfer (Yes) | | | | |
| No | 0.106*** | 0.0137 | 0.061*** | 0.011 |
| Don't know | 0.054** | 0.026 | 0.0161 | 0.023 |
| Advice | -0.026** | 0.012 | -0.023** | 0.010 |
| Training | 0.029** | 0.014 | 0.016 | 0.012 |
| Management training | 0.003 | 0.012 | 0.018* | 0.010 |
| Product innovation | 0.030*** | 0.011 | 0.018** | 0.010 |
| Process innovation | 0.000 | 0.012 | -0.006 | 0.010 |
| Government support (grant/loan) | 0.012 | 0.015 | -0.009 | 0.013 |
| Ease of obtaining finance (no recent finance) | | | | |
| No problems | -0.026** | 0.013 | -0.017** | 0.007 |
| Problems | -0.082*** | 0.030 | -0.051*** | 0.011 |
| Gender of management (male) | 0.008 | 0.018 | 0.0103 | 0.015 |
| Family business (no) | -0.027*** | 0.011 | -0.032*** | 0.010 |
| Herfindahl Index | 0.004 | 0.002 | 0.001 | 0.002 |
| Manufacturing | 0.005 | 0.013 | 0.003 | 0.011 |
| **Controls** | | | | |
| East of England | 0.019 | 0.0207 | 0.019 | 0.017 |
| London (d) | 0.039 | 0.0241 | 0.012 | 0.021 |
| North East (d) | -0.014* | 0.0320 | 0.008 | 0.026 |
| North West (d) | 0.000 | 0.0193 | 0.004 | 0.016 |
| South East (d) | 0.0297 | 0.0229 | 0.022 | 0.019 |
| South West (d) | 0.005 | 0.0255 | -0.001 | 0.022 |
| West Midlands (d) | -0.038 | 0.0293 | -0.003 | 0.024 |
| Yorkshire and the Humber (d) | 0.008 | 0.0301 | 0.028 | 0.024 |
| Wales (d) | 0.0278 | 0.0224 | 0.032* | 0.018 |
| Scotland (d) | 0.003 | 0.0224 | -0.005 | 0.019 |
| Northern Ireland (d) | 0.047 | 0.0377 | 0.077*** | 0.026 |
| Pseudo R2 | 0.050 | . | 0.042 | . |
| Chi-squared | 0.000*** | | 0.000*** | . |
| Observations | 5,317 | . | 5,317 | . |

Note: Robust standard errors. The East Midlands is the base category for the regions. *(d)* Dummy variable[14]. Significance levels: * 10%, ** 5%, ***1%. Based on SBS2006 data. Marginal effects reported.

[14] Please see Annex Table B5 for a description of how the relevant dummy variables are created.

Finally, it is shown that being a family business lowers the marginal probability of survival by around 3 per cent in both models. This resonates with the wider literature on family businesses, which suggests that a lower chance of survival for family firms may arise from conflicts, altruism, downsides of social capital, lower levels of risk taking and lower levels of R&D (cf. Schulze et al. 2003; Kellermanns and Eddleston, 2004; Gedajlovic et al., 2012, as summarised in Wilson et. al. 2013).

The range of interesting conclusions to draw from the models is somewhat offset by the low explanatory power of the model in general. Explaining only about 5 per cent of firm survival, the models are not very powerful, suggesting that key variables remain omitted.

### *Determinants of Employment Growth*

Following Lee (2011), it is relevant to assess the determinants of growth in economic activity[15]. Employment is going to be used as the main variable of interest. Davidsson et al (2009, p.395) imply that sales can also provide a useful indicator for many analyses, but highlights significant drawbacks. They suggest that change in sales turnover can be representative of a change in performance that is not reflective of effective value creation and is neither profitable nor sustainable. It is for this reason that Garnsey et al. (2006) suggest that changes in employment are a more conservative measure of firm performance that is more likely to reflect stable and persistent growth. In order to be willing to take on an additional employee a firm has to consider the growth it has achieved (in terms of sales turnover) to be representative of a non-temporary increase in business and profitability – for example, a new contract or a new customer. For this reason, among successful firms employment growth tends to follow a non-trivial increase in turnover and profitability rather than preceding it (Davidsson et al, 2009). Sales turnover by contrast, is a much more variable indicator which, because of this variability, tends to give the impression that there is a great deal of fluctuation in firm performance. An OLS model for turnover growth similar to the one in Table 11 is reported in Annex B, Table B10.

Starting with the probit model, 4,215 businesses are analysed of which 962 have above average employment growth. There is a skewness to firm growth with some businesses exhibiting very high employment growth (this specific characteristic of the data has been noted earlier). Log firm size and age have a negative, statistically-significant effect on the likelihood of being in the category of firms exhibiting above-average employment growth over 2007-14. For firm size the effect is quite pronounced. A one-unit increase in firm size has a negative average marginal effect on the likelihood of being in the category of firms exhibiting above-average employment growth of around 7 per cent. The significant coefficient of squared firm size, suggests that this negative impact is less pronounced for the largest firms in the sample. A similar pattern is found in the OLS model, where a further firm size variable has been included to squeeze out the effect of growth rate heterogeneity across firm size.

[15] The model of employment growth is based on the key points from comprehensive survey of growth studies (Coad et al., (2013)) where the importance of firm age, sector competition, human capital, gender (of founder), ownership structure, legal status, capital intensity, characteristics of management and diversification is highlighted. We have tried to encompass all these variables in the model and added variables unique to the SBS survey.

## Table 11: Determinants of firm growth from 2007-2014, Probit and OLS estimators.

| Dependent variable | Probit GLM Below/Above avg. growth (%) | | OLS regression Δ employment (%) | |
|---|---|---|---|---|
| | **Marginal Prob. (β)** | **s.e.** | **β** | **s.e.** |
| **Determinants, marginal effect** | | | | |
| Firm size (ln) | -0,066*** | 0,007 | -0,201*** | 0,015 |
| Firm size$^2$ | 0,000004*** | 0,000001 | 0,00005*** | 0,00001 |
| Firm size$^3$ | . | . | -0,00001*** | 0,000 |
| Age | -0,005*** | 0,001 | -0,003** | 0,001 |
| Expectation for future employment (Grow) | | | | |
| Same | -0,079*** | 0,015 | -0,125*** | 0,027 |
| Less than | -0,106*** | 0,020 | -0,205*** | 0,036 |
| Advice (d) | -0,003 | 0,014 | 0,015 | 0,025 |
| Training (d) | 0,046*** | 0,016 | 0,115*** | 0,028 |
| Management training (d) | -0,007 | 0,014 | 0,000 | 0,028 |
| Product innovation (d) | 0,018* | 0,010 | 0,026 | 0,024 |
| Process innovation (d) | 0,030** | 0,014 | 0,029 | 0,024 |
| Government support grant/loan (d) | 0,038** | 0,017 | 0,055* | 0,031 |
| Ease of obtaining finance (No recent finance) | | | | |
| No problems | 0,062** | 0,015 | 0,070*** | 0,028 |
| Problems | -0,043 | 0,029 | -0,105* | 0,060 |
| Gender of management (male) | 0,007 | 0,022 | 0,008 | 0,039 |
| Family business (d) | 0,026* | 0,013 | -0,013 | 0,025 |
| Herfindahl Index | -0,002 | 0,003 | -0,003 | 0,005 |
| Manufacturing (d) | -0,005 | 0,016 | 0,011 | 0,026 |
| **Controls** | | | | |
| East of England | 0,046* | 0,024 | 0,053 | 0,042 |
| London (d) | 0,045 | 0,029 | 0,029 | 0,052 |
| North East (d) | 0,013 | 0,036 | -0,087 | 0,071 |
| North West (d) | 0,011 | 0,021 | 0,027 | 0,037 |
| South East (d) | 0,005 | 0,026 | -0,030 | 0,050 |
| South West (d) | 0,022 | 0,029 | 0,024 | 0,053 |
| West Midlands (d) | 0,009 | 0,033 | -0,030 | 0,065 |
| Yorkshire and the Humber (d) | 0,006 | 0,034 | 0,019 | 0,055 |
| Wales (d) | 0,039 | 0,026 | 0,070* | 0,043 |
| Scotland (d) | 0,013 | 0,025 | 0,019 | 0,042 |
| Northern Ireland (d) | -0,089 | 0,037 | -0,137** | 0,069 |
| Constant | . | . | 0,451*** | 0,095 |
| Pseudo R2 | 0,079 | . | 0,085 | . |
| Chi-squared | 0.000*** | | 0.000*** | . |
| Observations | 4,215 | . | 4,215 | . |

Note: Robust standard errors. The East Midlands is the base category for the regions. *(d)* Dummy variable[16]. Significance levels: * 10%, ** 5%, ***1%. Based on SBS2006 data. Marginal effects presented for probit-model, OLS parameter estimates shown for OLS regression.

This finding provides some confidence in the accuracy of the linking procedure and the robustness of the data. Studies of firm performance show that newer, smaller firms are those that predominantly contribute to employment growth, which becomes more difficult to achieve the larger the firm. However, the effect is likely to underscore the problem of relative growth rates, rather than the *true* effect of firm size on growth.

As was the case in the survival model from Table 10, two variables are consistently showing high explanatory power across the models. The first is the survey variable on future expectations to growth. The parameter estimates show that expected growth and observed growth correlate strongly. The marginal effect of firms expecting to contract in the future, lowers the probability of seeing above average growth by 10 per cent,

[16] Please see Annex Table B5 for a description of how the relevant dummy variables are created.

compared to firms with expectations of future expansion. From the OLS model, it is seen that the average estimated growth rate differs by 20 per cent between the two groups. The second important determinant of an above-average rate of employment growth is ease of access to finance. Not having experienced any problems in raising finance recently, has an average marginal effect on the likelihood of being in the category of faster-growing firms of some 6%. This effect is found in the OLS model as well, where it seems to be even more significant.

Investment in training has a strong, statistically-significant average marginal effect on the likelihood of being in the category of firms exhibiting above-average employment growth 2007-2014. It increases this likelihood by close to 5%. The effect of training is also significant in the OLS modelling.

Both product and process innovation provide a more inconclusive picture. There is a statistically-significant average marginal effect on whether firms are in the category of exhibiting above-average employment growth during 2007-2014. In the OLS model neither of these variables are significant. The impact of product innovation on employment growth is widely known and evidenced; however, the effect from process innovation on the likelihood of being a fast-growing firm can be positive or negative. Process innovation is usually associated with productivity growth and efficiency, which in turn commonly are associated with decreases rather than increases in employment. However, reduced production costs stemming from process innovation are likely to lower marginal costs and profit margins may be maintained as market share growth allows employment growth.

A final interesting finding is that related to the question on government support in the form of grants or loans. Across both models, this variable shows a significant impact on growth across the period. Having been in contact with government about a specific grant or loan programme increases the likelihood of being an above-average grower by four per cent. In the OLS model, the effect is estimated to be a 5.5 per cent difference in employment growth across the period, comparing the two groups. The variable was not estimated to have any effect on firm survival, as shown in Table 10, but this suggests that financial support from government does increase employment growth among SMEs. The SBS does ask specifically about a range of Government support schemes, but the variable used here does not capture anything about the specific nature of the grant/loan provided.

Again, considering the full explanatory power of the growth models suggests that key variables explaining SME growth are omitted. Results could also highlight previous findings in the literature on the randomness of firm performance (Coad et al., 2013) amongst small and especially new firms. However, the analysis presented here shows the breadth of previously unobserved variables available for longitudinal analyses of SMEs with the linked version of the SBS2006 and 2007.

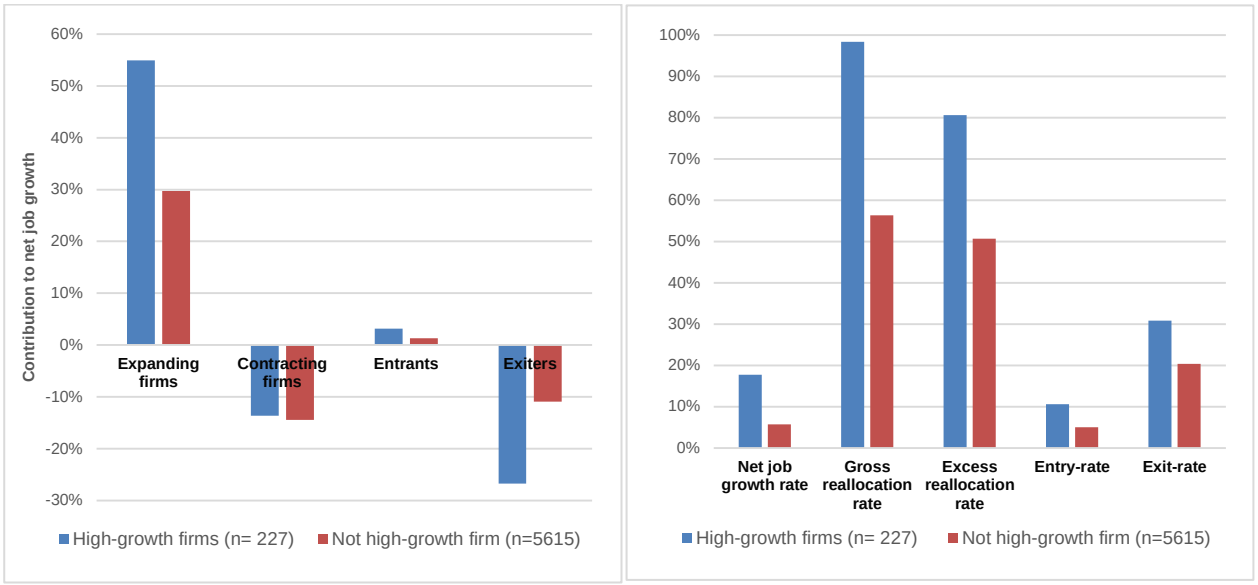
### *Decomposing patterns of job growth*

Looking at simple growth rates in employment tends to miss important dynamics of change. Davis and Haltiwanger (1999) pioneered a technique, later applied in the UK context by Anyadike-Danes, Bonner and Hart (2011), which makes it possible to unpack these dynamics. The analysis utilises access to a longitudinal firm-level database that permits the identification of the ‘demographic’ events of entry, exit and the growth/decline of survivors. The SBS survey responses can then be used to disaggregate the full sample by covariates of particular interest.

Anyadike-Danes et. al. (2011) defines job creation as the positive gross change in employment, summed over all businesses that expand or start up between two points in time, and job destruction as the negative gross change in employment summed over all businesses that contract or close between two points in time. The sum of the gross job creation rate and the gross job destruction rate is the gross job reallocation rate *($GROSS_t=JC_t+JD_t$)*, while the difference is the net aggregate employment growth rate *($NET_t=JC_t-JD_t$)* that can be observed in aggregate statistics. A measure of reallocation of jobs is the excess job reallocation rate. This is over and above the amount of job reallocation necessary to accommodate a given net aggregate employment growth rate. This is defined as the gross job reallocation rate minus the absolute net aggregate employment growth rate *($EXCESS_t = JR_t - |NET_t|$).* This technique unpacks dynamics of change across covariates of interest, and provides evidence on the differential effects of entry, exit or positive/negative growth in existing firms and the amount of economic churn.

A useful starting point for this analysis is to subdivide the firms into groups according to their net growth, and look at the heterogeneity of growth patterns across these groups. Using the definition of a high-growth firm (HGF) from Lee (2011)[17], it is possible to assess what drives growth in this group of firms and how it compares growth in firms that fall outside the category.

**Figure 7: Decomposition of employment growth, by growth category (2007-2014)**




Note: For definitions of terms see above. High-growth firms defined from survey responses. Based on SBS2006 data.

The graph on the left-hand side of Figure 7 shows the contribution of different groups of firms to net employment growth from 2007-2014. Four groups of firms are identified: expanding firms, contracting firms, entrants and exitors. In the analysis, these firms are weighted according to their relative size in the population of businesses, thus giving us their net contribution to growth. The figure shows how HGFs differ on more accounts than net growth rates. Unsurprisingly, expanding HGFs show significantly higher growth rates

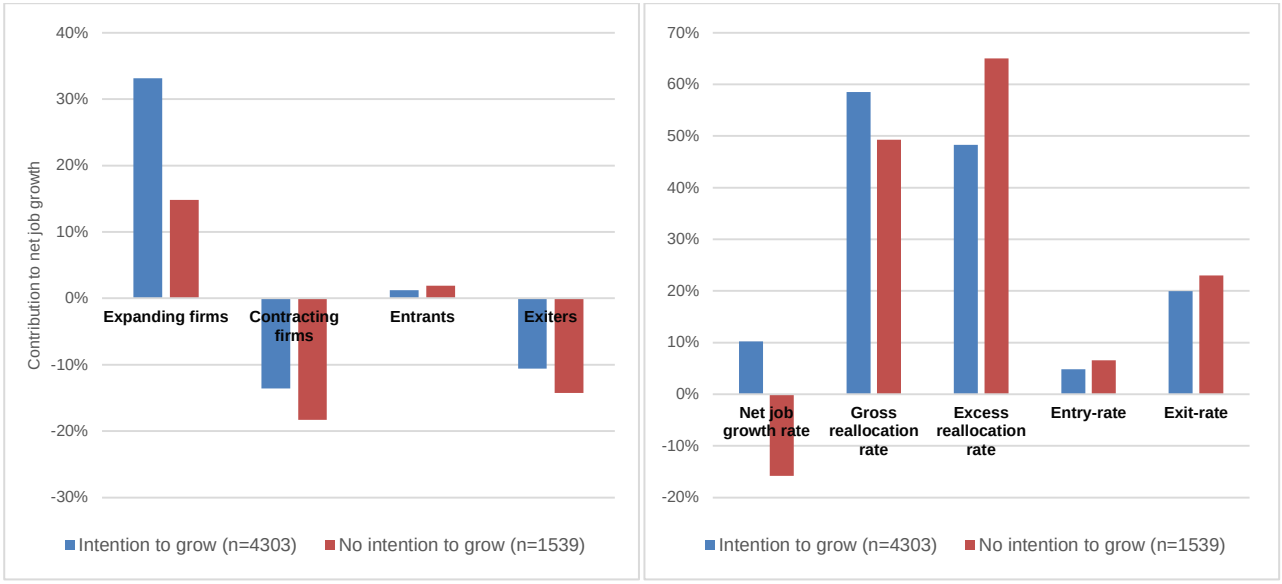
[17] HGF is identified as a firm that in the survey expects 20% employment growth per annum over a two-year period.

compared to non-HGFs (55 per cent compared to 30 per cent). However, many jobs are lost through exit in the HGF group (almost 10 per cent more than in the non-HGF group), suggesting that these firms are more likely to be acquired or fail due to risky growth strategies. Contracting firms show similar negative growth patterns across the two groups.

The more extreme growth patterns for expanding firms and higher exit rates are clearly illustrated in the right-side graph of Figure 7. This depicts metrics calculated from the numbers behind the left-side graph. As expected, the net growth rate is higher for the group of HGFs (by roughly 12 per cent). Behind this net growth in the group is a lot of turbulence and economic churn in the labour market, suggested by an excess reallocation rate of 80 per cent. The metric measures the extent to which job destruction exceeds the amount necessary to produce the observed net employment change. This is compared to an excess reallocation rate of roughly 30 per cent for non-HGFs.

The decomposition can also shed light on how covariates from the employment regression influences employment growth. This is achieved by disaggregating the decomposition by a range of relevant dummy-variables. The SBS contains questions about future intentions of businesses. One of the questions is: *"Over the next two to three years, do you aim to grow your business? (Y/N)".* Disaggregating the decomposition by the response to this question shows a somewhat unsurprising, but nevertheless interesting, relationship between intentions to grow and actual growth. The net growth rate for the 1,539 businesses that answered 'no' to the question is minus 16 per cent, driven by high levels of exit and contracting firms, whereas it is 10 per cent for those with intentions to grow in the period after the survey.

**Figure 8: Decomposition of employment growth, by growth intentions (2007-2014)**




Note: For definitions of terms see above. High-growth firms defined from survey responses. Based on SBS2006 data.

Other covariates have been analysed in a similar fashion, including financial benefit from government support (grant/loan), export behaviour, start-ups, gender of management and recent process innovation. Results are shown in Annex B7.

## Discussion

This brief analysis illustrates the benefits of using longitudinal data, made possible by the data-linking exercise. The effect on survival and growth of factors such as innovation or investment in training is difficult to identify using cross-sectional data in which indicators are contemporaneous. The effect of innovation on performance is perhaps the best example of this problem, as it can take many years to become evident. The preliminary analysis conducted here, however, illustrates that the effect of such factors can now be assessed using the linked data. This lays the foundations for subsequent, more detailed analyses.

Because of the difficulties associated with identifying the effect of particular determinants on firm performance, some recent, prominent research has even questioned the role played by firm resources or capabilities in firm growth. They have posited instead that firm performance is largely random (Coad et al., 2013), at least among newer firms. The analysis presented here provides an early indication that it is possible to identify factors associated with both firm survival and (employment) growth by linking together available data sources to facilitate analyses that are longitudinal in nature. This implies that the absence of an effect from firm resources/capabilities in other studies is an artefact of the data employed, which may be insufficiently longitudinal to capture the effects shown here.

A word of caution should be noted however. The average age of the 5,317 firms from the 2007 SBS included in the above survival analysis is 18 years. Firms established for some time have a lower propensity to cease to trade than newer firms, as reflected in the fact that from 5,317 in existence in 2007, only about 20% did not survive until 2014. This is a considerably lower hazard rate than exhibited by cohorts of new firms. Furthermore, the average firm size (in employment terms) in 2007 is 27, suggesting that the sample contains mostly medium-sized, or larger, firms, and fewer micro firms. Firm size has a significant effect on survivability as also indicated in Table 10. The survival and employment-growth dynamics of more established firms, and their association with particular determinants, is likely to be somewhat different to those of newly established firms.

# 7. Conclusion

This study has prepared a data file that allows analysts to link the 2006 and 2007 waves of the Small Business Survey to the ONS business datasets held in the Virtual Microdata Lab. The sections of the report present how the linking of these relatively old surveys was undertaken, some analysis of the comparability between SBS and ONS data and some initial analysis of the drivers of firm survival and growth.

This study builds on recent ONS work linking the 2010 and 2012 Small Business Surveys to the Inter-Departmental Business Register (IDBR). The ONS work was conducted in the last few years and so benefits from being undertaken relatively soon after the survey. For SBS 2010, the linking used the ONS business register in a more comprehensive manner, using powerful name and address linking algorithms, so that a higher linking rate was possible. However, the 2012 linking used a relatively crude linking strategy and so the number of survey responses satisfactorily linked to the IDBR was modest.

SBS2006 has 9,905 surveyed businesses, of which 8,640 agreed to have their data linked (87.3 per cent). For the SBS2007, those numbers are 9,362 and 7,985 (85.3 per cent). Table 2 indicates the results of this project's linking of SBS to the IDBR in the 2006 and 2007 survey waves and compares this with rates achieved by ONS for the 2010 and 2012 surveys. Compared with the IDBR linking of the 2010 survey, linking rates for SBS 2006 and 2007 are generally higher. Linking of the SBS 2012 is not directly comparable, as the linking method used differs considerably from the one used for the SBS 2006, 2007 and 2010.

**Table 2: Final linking rates for Small Business Survey waves[18]**

| | SBS 2006 | SBS 2007 | SBS 2010 | SBS 2012 |
|---|---|---|---|---|
| Total surveyed | 9,905 | 9,362 | 4,580 | 5,724 |
| Available for linking | 8,640 | 7,985 | 4,006 | 4,721 |
| IDBR enterprise references linked | 6,694 | 5,843 | 2,884 | 1,809 |
| **Link rate (%)** | **77%** | **73%** | **72%** | **38%** |

Overall, the achieved link rates are high and – as the 2006 and 2007 surveys were almost twice the size of the 2010 survey – the number of businesses successfully linked to the IDBR is more than double that available to analysts of the SBS 2010.

To assess the quality of the linking, three analyses were undertaken. The first focuses on the linking using the Companies House register, where the distance between the postcodes in the survey and the linked IDBR entry has been estimated to qualify a simple fuzzy link on business name. This distance measure was then used to set a threshold of acceptance. All links above this threshold where put through IDBR linking as well, to ensure robustness.

After constructing the final linked dataset, linking rates across important covariates from the survey were checked. This is done to ensure that link rates correlate with expectations

[18] 8,105 businesses did agree to be linked, but the number of businesses with ID data for linking was lower.

for sub-categories of businesses. As suggested by the SBS2010 linking exercise, it is expected that smaller non-incorporated businesses have a lower link rate than medium-sized companies.

Thirdly, clerical linking has been used to understand the main reasons behind failing to link these businesses to the IDBR. A sample of the businesses surveyed by SBS that could not be linked was taken. Each were characterised using survey responses and then various business databases were used to check that the businesses could not be linked to a registered business. This systematic clerical linking allows an assessment of the key reasons for being unable to achieve a link.

The linked data allows analysis about how reliable the self-reported survey responses are in comparison with equivalent estimates derived from the linked administrative data. The results indicate, on the whole, values are similar between the two sources, but they also point to some potential problems. The problems can have multiple sources. Firstly, differences could arise due to false links. Quality checks of the linking suggest this would not provide a complete explanation. Secondly, differences could indicate that survey responses or ONS data are incorrect. There is some evidence of this in the survey data. A third possible explanation is that the survey response is with respect to a different part of an entity than the record found in the linked IDBR entity. This is most likely to occur in complex business structures. A survey respondent may be answering about a particular plant or local unit, not covering the entirety of the business that is the focus of the business structures database. This difference in coverage would result in differences in employment or other measures even if the linking is high quality.

Lastly, there is the question about the source for IDBR employment numbers and the updating of this variable in the IDBR. IDBR uses a variety of sources and, for any business, will use that source which is believed to be most reliable at the time. Imputation is used for some businesses, and many businesses have employment estimates based on snapshots of the PAYE system. These sources are over-ridden with estimates from surveys where a business has fallen within the sample of one of the ONS employment surveys. There is then an issue of timing: if a respondent estimates employment at a particular time, there will be a lag as that level of employment enters the different administrative systems or is requested through an ONS survey.

The report ends by looking at the performance of the businesses that responded to the 2006 and 2007 waves of the SBS. It covers the period after the survey to 2013, including the impacts of the recession in 2008. In the first section, the linking to the IDBR is used to analyse using the ONS Business Structures Database whether the businesses survive. In the second section, some of the questions in the SBS are used to analyse the drivers for business survival.

This brief analysis illustrates the benefits of using longitudinal data, made possible by the data-linking exercise. The effect on survival and on employment growth of drivers such as innovation or investment in training is difficult to identify using cross-sectional data in which indicators are contemporaneous. The effect of innovation on performance is perhaps the best example of this problem, as it can take many years to become evident. The preliminary analysis conducted here, however, illustrates that the effect of such factors can now be assessed using the linked data. This lays the foundations for subsequent, more detailed analyses.

## Lessons Learnt

The final link rates for SBS 2006 and 2007 were not achieved through a single method. Multiple methods were tested on the datasets. This provides two lessons. Firstly, comparing the links achieved through different methods ensures robustness of the link. Secondly, there is value added by using fuzzy linking in a manner that is tailored to the register being used. For example, different registers treat the history of business change differently and the linking exercise can then adapt to the strengths of each registers.

An important part of this work was checking the quality of the links. The quality checks were conducted parallel to the linking work, not as a discreet check at the end of the linking. Assessing the quality of the linking at different stages proved an important part of improving the linking strategy. Triangulation of outcomes from different linking exercises also provided a validity measure.

This work focused on linking surveys to administrative data. It was found that even when linking is correct at entity level, the survey response might be about a different part of the entity than the record found in administrative data. This is most likely to occur in complex business structures. Analysts using the linked SBS will need to factor this into their work with the data. The study suggests that checking that the coverage of the survey coincides with the business in the IDBR is an important first step and that the very largest businesses, by IDBR employment, might be excluded from analysis, because the survey is unlikely to cover the large entity that the ONS data will be covering.

## Recommendations for Future Work

This linking work has provided a higher link rate than exercises undertaken for more recent SBS waves. There have also been some insights about how analysts using the linked datasets might use the linked data. These recommendations are outlined in the following:

- The link rate for medium-sized businesses may be improved by linking to the registers that are derived from Companies House data and using some of the sophisticated linking algorithms tailored to these registers. The continuing improvement of online linking tools will provide analysts with an easy and less time-consuming process of linking lists of businesses. It is shown that these procedures will improve link rates when list of businesses that needs to be linked to IDBR is old.

- The time lag between the survey year and the Business Structures Database year is around 2 years. That is, SBS 2006 corresponds most directly to data found in BSD 2007 or 2008. The analyses undertaken suggest that both of these years could be used for baseline-analysis. Analysts will have to take this into account in future analyses of the linked SBS.

- The linked SBS data needs some further processing to reduce noise from the linking process. Most pressingly, analysts will have to ensure that multi-plant businesses are linked so that data from the survey is covering the same plants and local units as the IDBR business. For the SBS2006 and 2007, a coverage variable is left in the final dataset accessible in the VML. This compares the survey question about the number of local units in the business, with the number of local units held on the register. If there are large differences between these two values, analysts

should consider the usefulness of the survey-IDBR link. Similarly, analysts can use the SME indicator, which is also in the dataset. This will largely have the same noise-reducing effect (see Figure 2). The preferred option is the SME indicator, which removes companies of more than 251 employees.

- Linking to the IDBR is more likely for SBS responses from certain types of businesses. The bias that arises from the linking process is that older, larger, VAT-registered companies are overrepresented, whereas sole proprietors and micro businesses are underrepresented. This suggests that the survey weights may not be suitable and a new weighting scheme for the linked SBS will have to be developed.

# 8. References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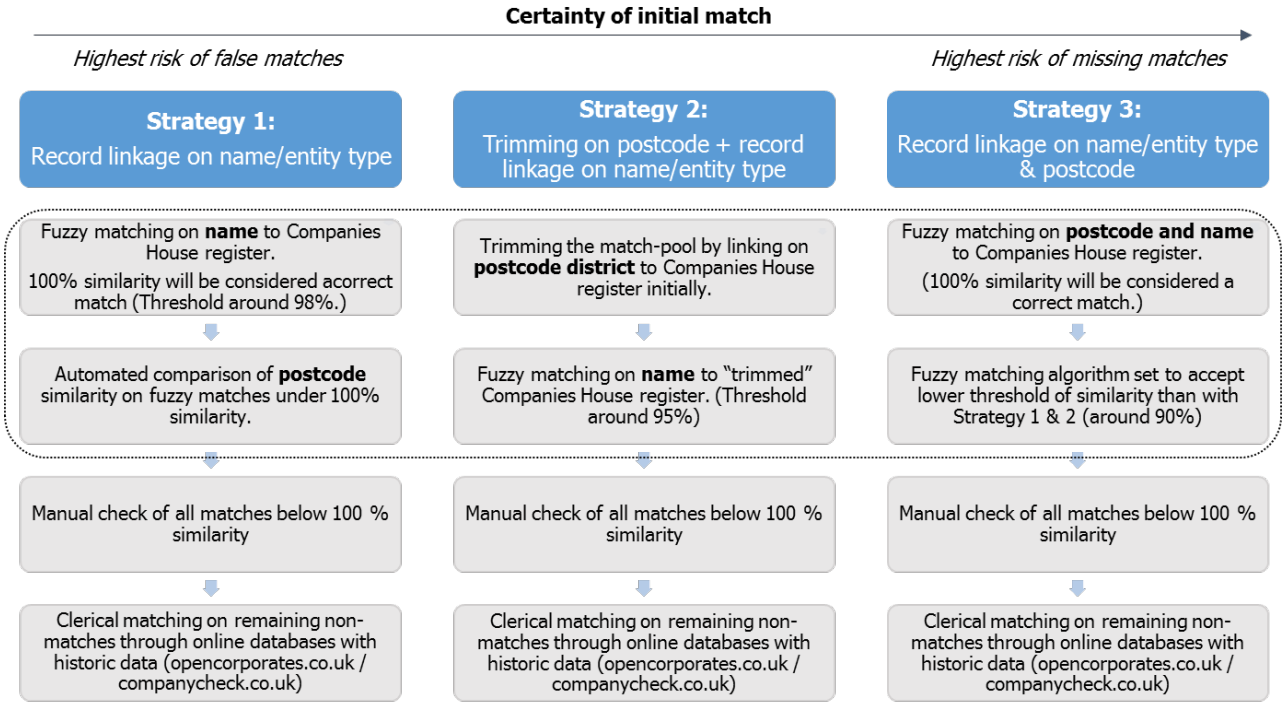
# ANNEX A: 2010 SBS Linking Review

For the 2010 Small Business Survey, linking to the Companies House register outside of ONS was pursued using three strategies, given in the figure below. These were undertaken both to understand the approach used to link 2010 SBS and to make improvements, particularly to help with the 2006 and 2007 linking where the surveys are older.

The first approach is most suitable where the sample to be linked is itself from a register, such as Dun and Bradstreet in the case of SBS. The approach will identify businesses by perfect name link across the survey and the Companies House register. As the sample has D&B names, the number of business with a "perfect" link could be high and then a check on postcode would confirm the link. The first name link would use fuzzy linking, but select only those links that provide a link score of 1 where the records are very similar.

**Figure A1: Strategies for linking Small Business Survey waves**




In the second approach, the linking uses geography first. The surveyed business' postcode is used to link on name and entity type only to those businesses in the Companies House register near to that location. This begins to restrict the name linking considerably, ruling out businesses with the same name but clearly in a different locale.

The final approach is similar to this second approach, linking on geography, name and entity type. The difference is that it will simultaneously use all three variables. These two approaches have one drawback. It relies on the address given by the survey respondent being that used by business registers. This may not be the case where there are multiple locations or where a business, when registering, uses the address of a business services provider.

All three approaches do end with clerical linking. Where no links are found, there is a potential to identify businesses from open data sources.

A key part of each approach is to quantify the quality of links. The businesses that are linked can be sampled and a check made to identify any systematic linking issues. For example, certain words in company names are known to be problematic, as they occur with very high frequency (Contractor, Associates), raising link scores artificially when linking on names. Simple quality checks can quantify this and linking algorithms improved.

In each approach the Stata command reclink2 was used. The SBS survey is loaded and then linked to a file of companies, in this case the Companies House database:

> *reclink2 companyname postcode entity_type using "CH register file", idmaster(key1) idusing(key2) gen(fuzzyscore) minscore(0.90)*

The four arguments define the survey name field, the register name field, the score to be calculated and the minimum acceptable score. An alternative code available in Excel is FuzzyVLookUp, which was tested alongside the Stata code.

## 2010 Data Linking Using Companies House

The SBS 2010 dataset consists of 4,580 businesses, which is reduced to 3,946 observations when cleaned for the sixty duplicates on business name and for businesses not willing to have their data linked. Only those that consented to linking were linked. The first step was to standardise business names (see Section 3 on Linking SBS 2006/2007 for further detail on this procedure) and link using that field where names were 100% similar between the survey and Companies House. The Companies House number was then appended to the survey record. Secondly, a fuzzy link on name and postcode was done. Links were quality assured manually and a threshold of 90% similarity was chosen, as all businesses were correctly linked above this percentage of similarity. Clerical linking was not performed on businesses that remained unlinked after these two stages, such as through looking to websites.

Table A1 provides an overview of the results and there is a similarity with those from the earlier ONS study. The upper panel indicates results including those businesses that declined to be linked and so is directly comparable to table 1 from ONS work. The lower panel removes these businesses from the total. As no attempt has been made to link these businesses, the total linked remain unchanged and only the totals unlinked are reduced.

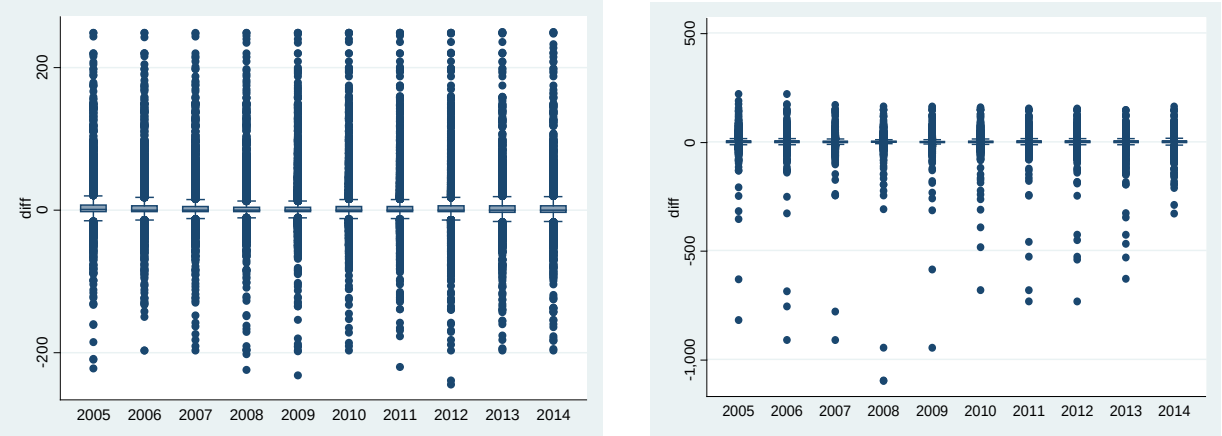
# ANNEX B: Additional Tables

### Table B1: Coverage statistics and average employment for SBS 2007

| Coverage | Mean | p50 | p75 | Std. Dev | Count |
|---|---|---|---|---|---|
| **0 – 25 %** | -45663.82 | -2912.00 | -76.00 | 74626.25 | 115 |
| **25.1 – 50 %** | -99.55 | -3.50 | 3.00 | 769.96 | 160 |
| **50.1 – 75 %** | -100.75 | -1.50 | 8.00 | 651.65 | 44 |
| **75.1 – 99 %** | -9.83 | -2.00 | 4.50 | 46.40 | 24 |
| **99.1-100.1 %** | 2.06 | 0.00 | 5.00 | 44.70 | 3259 |
| **Total** | -1461.75 | 0.00 | 5.00 | 15517.51 | 3602 |

Note: SBS2007, using BSD 2008 employment values.

### Figure B2: Box plots of employment differences, by year of BSD




The boxplots in Figure B3 shows the differences in employment and how it's behaving over time. The plot on the left applies the >250 employment rule whereas the one on the right applies the coverage=100% rule.

### Table B3: Source of BSD information

| Source | | VAT | | PAYE | | VAT and PAYE | |
|---|---|---|---|---|---|---|---|
| | | **Diff (levels)** | **Diff (%)** | **Diff (levels)** | **Diff (%)** | **Diff (levels)** | **Diff (%)** |
| Not registered | Mean | 5.7 | 1.6 | 12.5 | 4.6 | 6.1 | 2.0 |
| | Median | 0 | 0 | -1 | -0.5 | 0 | 0 |
| | N | 229 | 223 | 138 | 132 | 535 | 529 |
| Registered | Mean | 3.9 | 0.7 | 3.7 | 0.7 | 3.7 | 0.6 |
| | Median | 0 | 0 | 0 | 0 | 0 | 0 |
| | N | 2954 | 2954 | 2961 | 2961 | 2710 | 2710 |
| Total | Mean | 4.0 | 0.8 | 4.1 | 0.8 | 4.1 | 0.8 |
| | Median | 0 | 0 | 0 | 0 | 0 | 0 |
| | N | 3183 | 3177 | 3099 | 3093 | 3245 | 3239 |

Note: For SBS2007. The difference is calculated as (SBS2006 employment) – (BSD employment 2007). See Annex B4 for SBS2007 table. Threshold rule applied: both <251 employment and coverage=100 per cent.

## Table B4.1: Comparison of employment values by survey size category

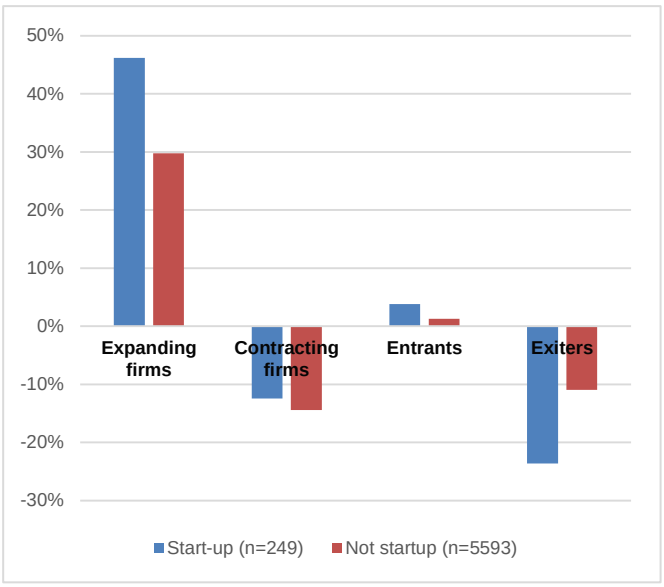
| | SBS 2006 | | | SBS 2007 | | | SBS 2010 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | N | Mean | Median | N | Mean | Median | N |
| **None** | 4,271.2 | 2 | 402 | 1,642.8 | 2 | 583 | 192.8 | 2 | 296 |
| **1-9 Micro** | 2,458.2 | 4 | 2,040 | 1,535.9 | 4 | 1,844 | 432.7 | 4 | 957 |
| **10-49 Small** | 392.5 | 16 | 2,528 | 593.9 | 16 | 2,048 | 127.7 | 18 | 1,046 |
| **50-250 Medium** | 653.4 | 66 | 1,150 | 431.4 | 64 | 892 | 181.3 | 72 | 510 |
| **Total** | 1,384.8 | 11 | 6,120 | 1,004.5 | 9 | 5,367 | 248.2 | 11 | 2,809 |

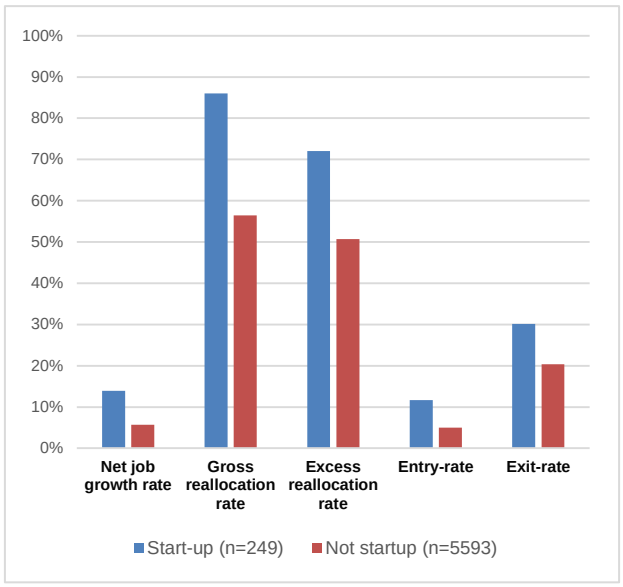
Note: This calculation only includes all businesses in the year following the survey in the BSD (i.e. for SBS 2006, BSD 2007 employment values are used). Comparable to table 7.

## Table B5: Creation of variables for survival and growth analysis

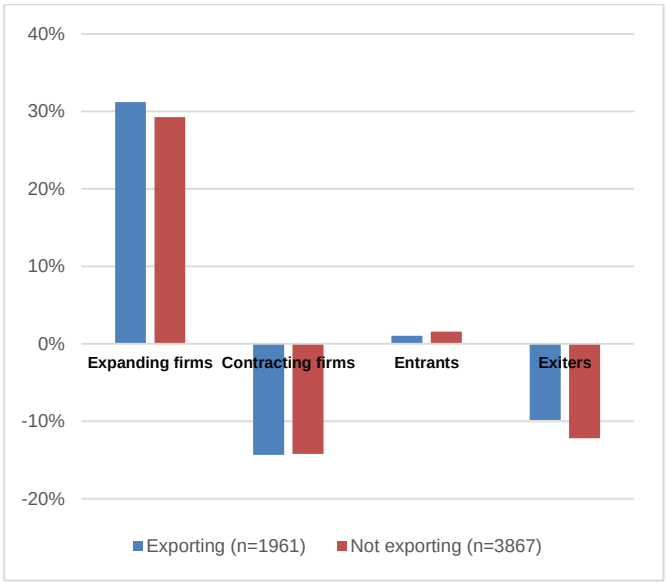
| Name in Table 1 | Question in SBS | Definition of binary variable |
|---|---|---|
| **Advice** | 98 | **Firms seeking any sort of business advice in the 12 mths prior to the survey are separated out from firms not seeking any advice, from any source, or responding 'don't know'** |
| **Training** | 137 | **Firms funding or arranging any sort of training in the 12 mths prior to the survey are separated out from firms not arranging training, or responding 'don't know** |
| **Management training** | 139 | **The question asks what % of managers in the business have had training. The mean for the sample is 21.4%. The variables is dichotomised by categorising firms as above or below the mean.** |
| **Product innovation** | 86 | **Firms introducing a new or significantly improved product in the 12 mths prior to the survey are separated out from those that did not, or responding 'Don't know'.** |
| **Process innovation** | 88 | **Firms introducing a new or significantly improved process in the 12 mths prior to the survey are separated out from those that did not, or responding 'Don't know'.** |
| **Ease of obtaining finance** | 72 | Firms could answer: 1) Did not seek finance, 2) did seek finance and had problems, 3) did seek finance and had no problems. |
| **Ambition of future growth** | 18 | Could you tell me whether you expect it to have employed: 1) More, 2) the same or 3) fewer in 12 months' time? |
| **Government grant/loan** | 128 | Have you had any contact in the way just described with Government departments or agencies in the last twelve months in the following areas… "Claiming grant or loans" (dummy) |
| **Expectation of closure/full transfer of ownership** | 161 | Do you anticipate the closure, or a full transfer of the ownership of your business in the next 5 years? (Yes, No, Don't know) |
| **Sector: Manu or other** | **From IDBR** | **Firms in the Manufacturing section on the SIC classification are separated out from those in other industries.** |

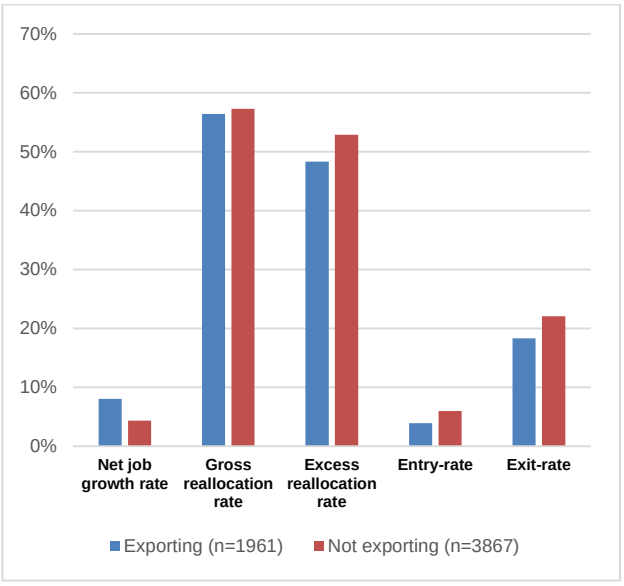
## Table B6: Decompositions, by different covariates, with SME threshold rule active



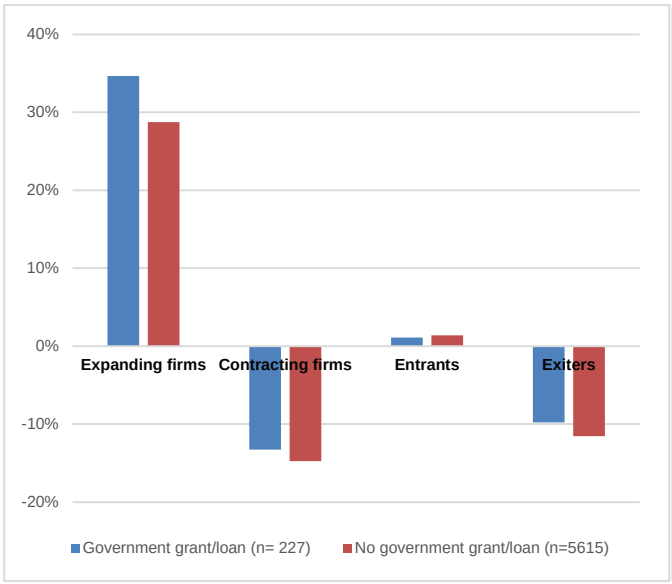



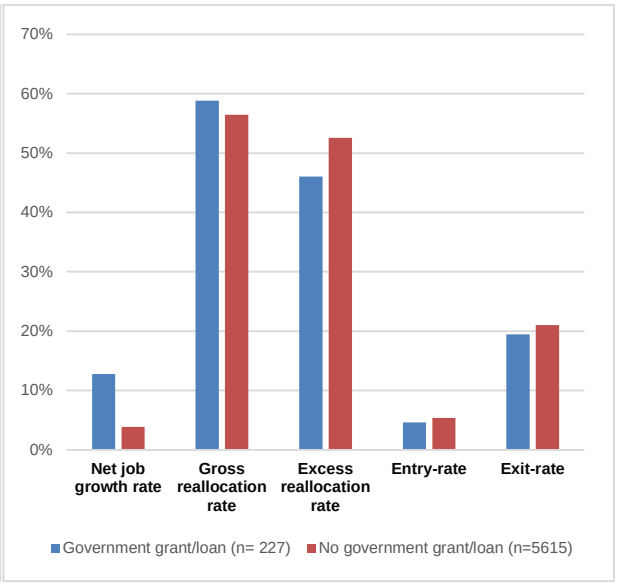

Note: Dependent variable: self-reported start-up status. SBS2006. See main text for explanation and definitions.



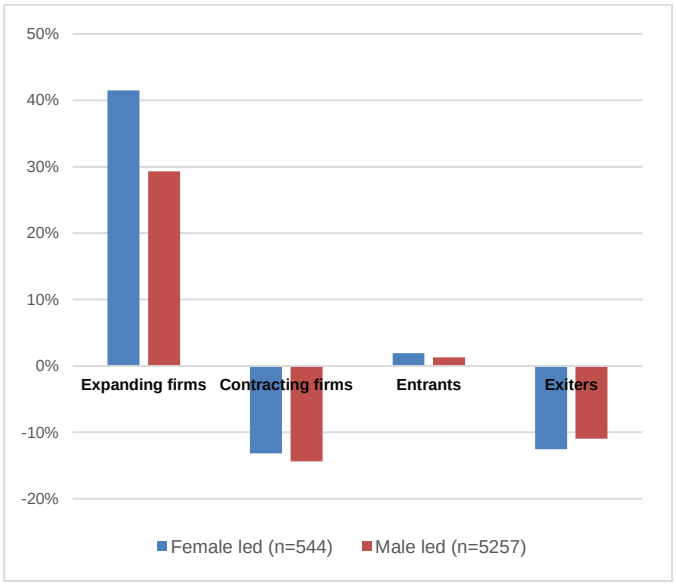



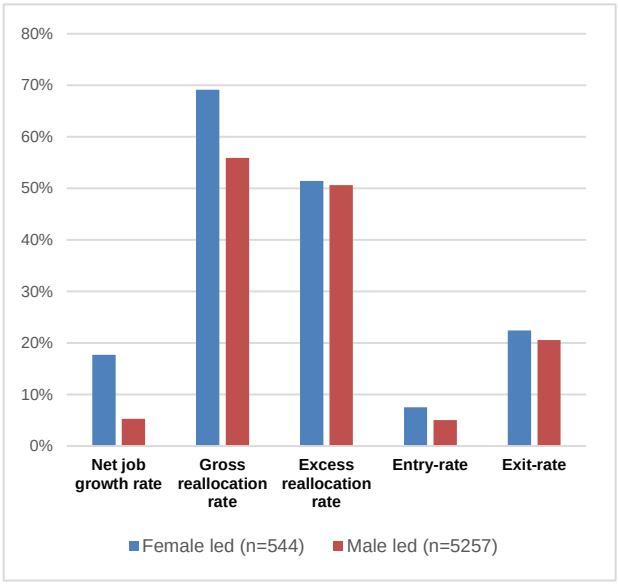

Note: Dependent variable: self-reported exporting status. SBS2006. See main text for explanation and definitions.



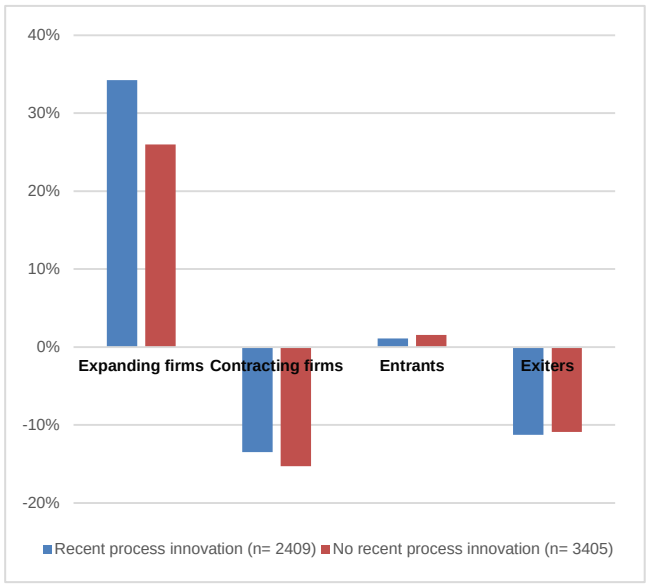



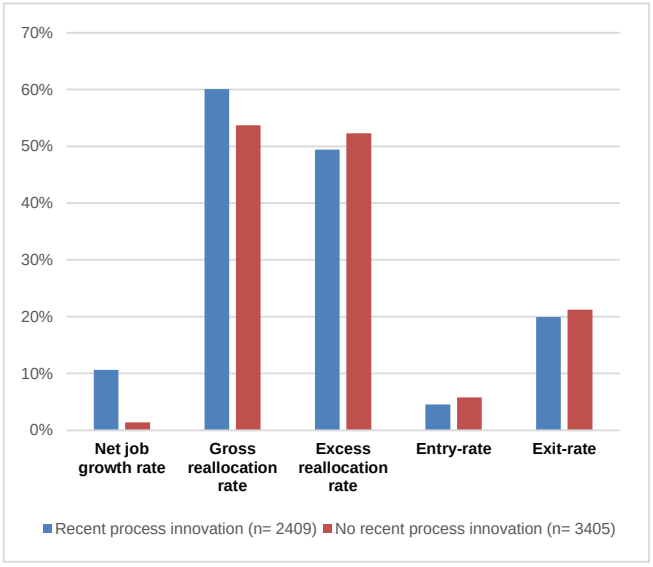

Note: Dependent variable: self-reported exporting status. SBS2006. See main text for explanation and definitions.




Note: Dependent variable: gender of management. SBS2006. See main text for explanation and definitions.




Note: Dependent variable: recent process innovation. SBS2006. See main text for explanation and definitions.

**Table B7: Measures of association between self-reported and actual growth**

The two tables report *actual* and *expected percentages*. Below each comparison is the corresponding chi-squared statistic and the appropriate critical value. The grey cells highlight the direction of the expected relationship, as they pair up a survey-entry to the corresponding BSD growth pattern. Survey responses are listed in the rows, BSD in the columns. The relationships is tested on one year employment growth windows from 2005 – 2009 to assess when the survey data is most similar to BSD growth. All the analyses are undertaken with the BSD-SME threshold rule active.

## Employment variable:

### B7.1 SBS 2006: Self-reported past employment growth versus actual employment growth from BSD

| Survey response | BSD 2005 – 2006 | | | | BSD 2006 - 2007 | | | | BSD 2007 - 2008 | | | | BSD 2008 - 2009 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BSD** | Downsize | Remain | Grow | Total | Downsize | Remain | Grow | Total | Downsize | Remain | Grow | Total | Downsize | Remain | Grow | Total |
| Downsized in the last 12 months | **17%** | 61% | 22% | 100% | **31%** | 48% | 21% | 100% | **36%** | 50% | 14% | 100% | **29%** | 54% | 17% | 100% |
| | **16%** | 60% | 24% | 100% | **22%** | 50% | 28% | 100% | **21%** | 54% | 25% | 100% | **22%** | 54% | 25% | 100% |
| Remained the same in 12 months | 16% | **64%** | 20% | 100% | 21% | **53%** | 26% | 100% | 19% | **59%** | 21% | 100% | 21% | **57%** | 22% | 100% |
| | 16% | **60%** | 23% | 100% | 22% | **50%** | 28% | 100% | 21% | **54%** | 25% | 100% | 22% | **54%** | 25% | 100% |
| Grown in the last 12 months | 16% | 52% | **32%** | 100% | 18% | 44% | **38%** | 100% | 14% | 47% | **39%** | 100% | 19% | 46% | **35%** | 100% |
| | 16% | 60% | **23%** | 100% | 22% | 50% | **29%** | 100% | 21% | 54% | **25%** | 100% | 22% | 54% | **25%** | 100% |
| Total | 16% | 60% | 23% | 100% | 22% | 50% | 28% | 100% | 21% | 54% | 25% | 100% | 22% | 54% | 25% | 100% |
| | Pearson= 89.2 Pr = 0.000 | | | | Pearson = 133.6 Pr = 0.000 | | | | Pearson= 379.1 Pr = 0.000 | | | | Pearson = 155.5 Pr = 0.000 | | | |

### B7.2 SBS 2007: Self-reported past employment growth versus actual employment growth from BSD

| Survey response | BSD 2006 - 2007 | | | | BSD 2007 - 2008 | | | | BSD 2008 - 2009 | | | | BSD 2009 - 2010 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BSD** | Downsize | Remain | Grow | Total | Downsize | Remain | Grow | Total | Downsize | Remain | Grow | Total | Downsize | Remain | Grow | Total |
| Downsized in the last 12 months | **25%** | 50% | 26% | 100% | **25%** | 54% | 21% | 100% | **33%** | 51% | 16% | 100% | **28%** | 58% | 14% | 100% |
| | **20%** | 53% | 28% | 100% | **20%** | 55% | 25% | 100% | **19%** | 55% | 26% | 100% | **22%** | 57% | 21% | 100% |
| Remained the same in 12 months | 19% | **57%** | 24% | 100% | 20% | **57%** | 22% | 100% | 19% | **60%** | 21% | 100% | 20% | **62%** | 18% | 100% |
| | 20% | **53%** | 28% | 100% | 20% | **55%** | **25%** | 100% | 19% | **55%** | 26% | 100% | 22% | **57%** | 21% | 100% |
| Grown in the last 12 months | 18% | 44% | **38%** | 100% | 16% | 48% | **36%** | 100% | 12% | 45% | **44%** | 100% | 23% | 46% | **31%** | 100% |
| | 20% | 53% | **28%** | 100% | 20% | 55% | 25% | 100% | 19% | 55% | **26%** | 100% | 22% | 57% | **21%** | 100% |
| Total | 20% | 53% | 28% | 100% | 20% | 55% | 25% | 100% | 19% | 55% | 26% | 100% | 22% | 57% | 21% | 100% |
| | Pearson= 78.7 Pr = 0.000 | | | | Pearson= 109.3 Pr = 0.000 | | | | Pearson= 355.7 Pr = 0.000 | | | | Pearson= 157.5 Pr = 0.000 | | | |

## B7.3 SBS 2006: Self-reported future employment growth (12-months ahead) versus actual employment growth from BSD

| Survey response | BSD 2006 – 2007 | | | | BSD 2007 - 2008 | | | | BSD 2008 - 2009 | | | | BSD 2009 - 2010 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BSD** | Fewer | Same | More | Total | Fewer | Same | More | Total | Fewer | Same | More | Total | Fewer | Same | More | Total |
| More than currently | 20% | 46% | **34%** | 100% | 18% | 49% | **32%** | 100% | 19% | 49% | **31%** | 100% | 25% | 50% | **25%** | 100% |
| | 22% | 50% | **28%** | 100% | 21% | 54% | **25%** | 100% | 22% | 54% | **25%** | 100% | 24% | 56% | **20%** | 100% |
| The same | 22% | **53%** | 25% | 100% | 20% | **58%** | 22% | 100% | 21% | **57%** | 22% | 100% | 22% | **59%** | 18% | 100% |
| | 22% | **50%** | 28% | 100% | 21% | **54%** | 25% | 100% | 22% | **54%** | 25% | 100% | 24% | **56%** | 20% | 100% |
| Fewer | **26%** | 44% | 30% | 100% | **29%** | 50% | 21% | 100% | **30%** | 50% | 20% | 100% | **26%** | 55% | 19% | 100% |
| | **22%** | 50% | 29% | 100% | **21%** | 54% | 25% | 100% | **22%** | 54% | 25% | 100% | **24%** | 56% | 21% | 100% |
| Total | 22% | 50% | 28% | 100% | 21% | 54% | 25% | 100% | 22% | 54% | 25% | 100% | 24% | 56% | 21% | 100% |
| | Pearson= 59.7 Pr = 0.000 | | | | Pearson = 111.8 Pr = 0.000 | | | | Pearson= 86.9 Pr = 0.000 | | | | Pearson = 51.9 Pr = 0.000 | | | |

## B7.4 SBS 2007: Self-reported future employment growth (12-months ahead) versus actual employment growth from BSD

| Survey respons | BSD 2007 - 2008 | | | | BSD 2008 - 2009 | | | | BSD 2009 - 2010 | | | | BSD 2010 - 2011 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BSD** | Fewer | Same | More | Total | Fewer | Same | More | Total | Fewer | Same | More | Total | Fewer | Same | More | Total |
| More than currently | 19% | 50% | **31%** | 100% | 18% | 48% | **34%** | 100% | 23% | 48% | **29%** | 100% | 24% | 54% | **22%** | 100% |
| | 20% | 55% | **25%** | 100% | 19% | 55% | **26%** | 100% | 22% | 57% | **21%** | 100% | 22% | 60% | **18%** | 100% |
| The same | 20% | **57%** | 24% | 100% | 19% | **59%** | 22% | 100% | 20% | **62%** | 18% | 100% | 21% | **63%** | 16% | 100% |
| | 20% | **55%** | 25% | 100% | 19% | **55%** | 26% | 100% | 22% | **57%** | 21% | 100% | 22% | **60%** | 18% | 100% |
| Fewer | **22%** | 56% | 22% | 100% | **22%** | 53% | 24% | 100% | **27%** | 57% | 16% | 100% | **22%** | 60% | 19% | 100% |
| | **20%** | 55% | 25% | 100% | **19%** | 55% | 26% | 100% | **22%** | 57% | 21% | 100% | **22%** | 60% | 18% | 100% |
| Total | 20% | 55% | 25% | 100% | 19% | 55% | 26% | 100% | 22% | 57% | 21% | 100% | 22% | 60% | 18% | 100% |
| | Pearson= 38.2 Pr = 0.000 | | | | Pearson= 113.1 Pr = 0.000 | | | | Pearson= 76.1 Pr = 0.000 | | | | Pearson= 31.7 Pr = 0.000 | | | |

## Turnover variable:

### B7.5 SBS 2006: Self-reported past turnover growth versus actual turnover growth from BSD

| Survey response | BSD | BSD 2005 – 2006 | | | | BSD 2006 - 2007 | | | | BSD 2007 - 2008 | | | | BSD 2008 - 2009 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total |
| | Increased turnover the last 12 months | **63%** | 30% | 8% | 100% | **61%** | 30% | 9% | 100% | **69%** | 22% | 9% | 100% | **59%** | 30% | 11% | 100% |
| | | **58%** | 34% | 8% | 100% | **50%** | 41% | 10% | 100% | **53%** | 36% | 11% | 100% | **53%** | 33% | 14% | 100% |
| | Decreased turnover the last 12 months | 50% | **41%** | 9% | 100% | 33% | **57%** | 10% | 100% | 27% | **60%** | 13% | 100% | 44% | **36%** | 19% | 100% |
| | | 58% | **34%** | 8% | 100% | 50% | **41%** | 10% | 100% | 53% | **36%** | 11% | 100% | 53% | **33%** | 14% | 100% |
| | Turnover stayed the same last 12 months | 56% | 35% | **8%** | 100% | 45% | 45% | **9%** | 100% | 45% | 44% | **12%** | 100% | 50% | 36% | **14%** | 100% |
| | | 58% | 34% | **8%** | 100% | 50% | 41% | **10%** | 100% | 53% | 36% | **11%** | 100% | 53% | 33% | **14%** | 100% |
| | Total | 58% | 34% | 8% | 100% | 50% | 41% | 10% | 100% | 53% | 36% | 11% | 100% | 53% | 33% | 14% | 100% |
| | | Pearson= 56.2 Pr = 0.000 | | | | Pearson = 336.7 Pr = 0.000 | | | | Pearson= 723.6 Pr = 0.000 | | | | Pearson = 117.8 Pr = 0.000 | | | |

### B7.6 SBS 2007: Self-reported past turnover growth versus actual turnover growth from BSD

| Survey response | BSD | BSD 2006 - 2007 | | | | BSD 2007 - 2008 | | | | BSD 2008 - 2009 | | | | BSD 2009 - 2010 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total |
| | Increased turnover the last 12 months | **59%** | 33% | 8% | 100% | **66%** | 26% | 8% | 100% | **69%** | 22% | 9% | 100% | **46%** | 42% | 12% | 100% |
| | | **52%** | 39% | 9% | 100% | **55%** | 35% | 9% | 100% | **55%** | 34% | 11% | 100% | **42%** | 43% | 15% | 100% |
| | Decreased turnover the last 12 months | 41% | **50%** | 9% | 100% | 39% | **50%** | 11% | 100% | 31% | **55%** | 14% | 100% | 32% | **47%** | 21% | 100% |
| | | 52% | **39%** | 9% | 100% | 55% | **35%** | 9% | 100% | 55% | **34%** | 11% | 100% | 42% | **43%** | 15% | 100% |
| | Turnover stayed the same last 12 months | 47% | 43% | **10%** | 100% | 49% | 41% | **10%** | 100% | 47% | 41% | **11%** | 100% | 42% | 42% | **16%** | 100% |
| | | 52% | 39% | **9%** | 100% | 55% | 35% | **9%** | 100% | 55% | 34% | **11%** | 100% | 42% | 43% | **15%** | 100% |
| | Total | 52% | 39% | 9% | 100% | 55% | 35% | 9% | 100% | 55% | 34% | 11% | 100% | 42% | 43% | 15% | 100% |
| | | Pearson= 118.1 Pr = 0.000 | | | | Pearson = 261.6 Pr = 0.000 | | | | Pearson=474.9 Pr = 0.000 | | | | Pearson = 90.4 Pr = 0.000 | | | |

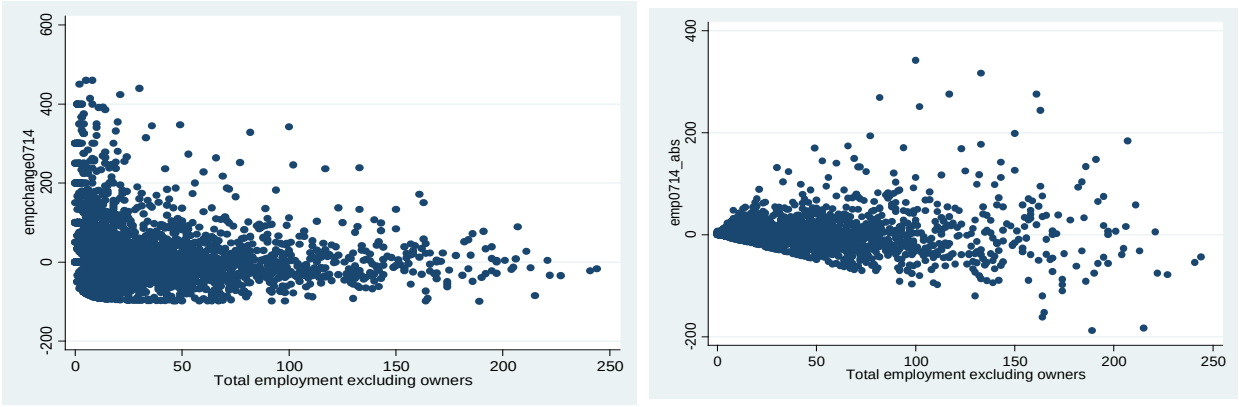
## B7.7 SBS 2006: Self-reported future turnover growth (12-months ahead) versus actual turnover growth from BSD

| Survey response | BSD 2006 – 2007 | | | | BSD 2007 - 2008 | | | | BSD 2008 - 2009 | | | | BSD 2009 - 2010 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BSD | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total |
| Increased turnover the last 12 months | **53%** | 37% | 11% | 100% | **58%** | 31% | 11% | 100% | **57%** | 29% | 14% | 100% | **42%** | 39% | 18% | 100% |
| | **50%** | 41% | 10% | 100% | **53%** | 36% | 11% | 100% | **53%** | 33% | 14% | 100% | **40%** | 42% | 18% | 100% |
| Decreased turnover the last 12 months | 44% | **48%** | 8% | 100% | 36% | **52%** | 12% | 100% | 39% | **44%** | 17% | 100% | 31% | **48%** | 21% | 100% |
| | 50% | **41%** | 10% | 100% | 53% | **36%** | 11% | 100% | 53% | **33%** | 14% | 100% | 40% | **42%** | 18% | 100% |
| Turnover stayed the same last 12 months | 47% | 45% | **8%** | 100% | 48% | 41% | **11%** | 100% | 49% | 37% | **13%** | 100% | 38% | 44% | **18%** | 100% |
| | 50% | 41% | **10%** | 100% | 53% | 36% | **11%** | 100% | 53% | 33% | **14%** | 100% | 40% | 42% | **18%** | 100% |
| Total | 50% | 41% | 10% | 100% | 53% | 36% | 11% | 100% | 53% | 33% | 14% | 100% | 40% | 42% | 18% | 100% |
| | Pearson= 55.6 Pr = 0.000 | | | | Pearson = 134.6 Pr = 0.000 | | | | Pearson= 89.6 Pr = 0.000 | | | | Pearson = 35.6 Pr = 0.000 | | | |

## B7.8 SBS 2007: Self-reported future turnover growth (12-months ahead) versus actual turnover growth from BSD

| Survey respons | BSD 2007 - 2008 | | | | BSD 2008 - 2009 | | | | BSD 2009 - 2010 | | | | BSD 2010 - 2011 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BSD | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total | Increase | Decrease | Stay same | Total |
| Increased turnover the last 12 months | **58%** | 32% | 10% | 100 % | **59%** | 30% | 11% | 100% | **48%** | 38% | 15% | 100% | **36%** | 52% | 12% | 100% |
| | **55%** | 35% | 9% | 100 % | **55%** | 34% | 11% | 100% | **42%** | 43% | 15% | 100% | **34%** | 53% | 12% | 100% |
| Decreased turnover the last 12 months | 52% | **37%** | 11% | 100 % | 44% | **44%** | 13% | 100% | 26% | **55%** | 19% | 100% | 33% | **51%** | 16% | 100% |
| | 55% | **35%** | 9% | 100 % | 55% | **34%** | 11% | 100% | 42% | **43%** | 15% | 100% | 34% | **53%** | 12% | 100% |
| Turnover stayed the same last 12 months | 52% | 39% | **8%** | 100 % | 52% | 37% | **11%** | 100% | 40% | 46% | **14%** | 100% | 32% | 56% | **12%** | 100% |
| | 55% | 35% | **9%** | 100 % | 55% | 34% | **11%** | 100% | 42% | 43% | **15%** | 100% | 34% | 53% | **12%** | 100% |
| Total | 55% | 35% | 9% | 100 % | 55% | 34% | 11% | 100% | 42% | 43% | 15% | 100% | 34% | 53% | 12% | 100% |
| | Pearson= 34.2 Pr = 0.000 | | | | Pearson= 59.2 Pr = 0.000 | | | | Pearson= 109.4 Pr = 0.000 | | | | Pearson= 17.7 Pr = 0.028 | | | |

## Table B8: Heteroscedasticity of continuous growth rates by firm size




Graph on the left plots the BSD employment (X-axis) against the growth-rates from 2007-2014 across all surveyed businesses. The graph on the right plots it against the absolute change in employment. The graphs show heteroscedasticity, which renders OLS regression prone to imprecise parameter estimates.

## Table B9: Comparison of turnover values by survey turnover categories

For both SBS2006 and 2007, there is a strong correlation between survey and BSD turnover. The analyses are undertaken with the BSD-SME threshold rule.

| Survey response SBS2006<br>BSD value | Less than 61,000 | 61,000 - 99,000 | 100,000 - 249,999 | 250,000 - 499,999 | 500,000 - 999,999 | 1m - 1.49m | 1.5m - 2.8m | More than 2.8m | Don't know | Refused | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Less than 61,000** | **29%** | 13% | 15% | 7% | 6% | 3% | 5% | 6% | 9% | 7% | 100% |
| | **5%** | 3% | 10% | 11% | 14% | 10% | 12% | 23% | 5% | 6% | 100% |
| **61,000 - 99,000** | 17% | **20%** | 24% | 8% | 4% | 4% | 3% | 5% | 6% | 9% | 100% |
| | 5% | **3%** | 10% | 11% | 14% | 10% | 12% | 23% | 5% | 6% | 100% |
| **100,000 - 249,999** | 8% | 4% | **39%** | 18% | 7% | 3% | 3% | 3% | 7% | 8% | 100% |
| | 5% | 3% | **10%** | 11% | 14% | 10% | 12% | 23% | 5% | 6% | 100% |
| **250,000 - 499,999** | 3% | 2% | 10% | **40%** | 20% | 3% | 4% | 3% | 7% | 9% | 100% |
| | 5% | 3% | 10% | **11%** | 14% | 10% | 12% | 23% | 5% | 6% | 100% |
| **500,000 - 999,999** | 1% | 1% | 3% | 8% | **50%** | 17% | 5% | 4% | 5% | 6% | 100% |
| | 5% | 3% | 10% | 11% | **14%** | 10% | 12% | 23% | 5% | 6% | 100% |
| **1m - 1.49m** | 1% | 0% | 2% | 2% | 9% | **48%** | 23% | 6% | 5% | 4% | 100% |
| | 5% | 3% | 10% | 11% | 14% | **10%** | 12% | 23% | 5% | 6% | 100% |
| **1.5m - 2.8m** | 1% | 0% | 1% | 2% | 3% | 10% | **55%** | 20% | 4% | 4% | 100% |
| | 5% | 3% | 10% | 11% | 14% | 10% | **12%** | 23% | 5% | 6% | 100% |
| **More than 2.8m** | 0% | 0% | 0% | 1% | 2% | 2% | 5% | **84%** | 2% | 3% | 100% |
| | 5% | 3% | 10% | 11% | 14% | 10% | 12% | **23%** | 5% | 6% | 100% |
| **Total** | 5% | 3% | 10% | 11% | 14% | 10% | 12% | 23% | 5% | 6% | 100% |

**Pearson chi2(63) = 9.7e+03 Pr = 0.000**

| Survey response SBS2007<br>BSD value | Less than 61,000 | 61,000 - 99,000 | 100,000 - 249,999 | 250,000 - 499,999 | 500,000 - 999,999 | 1m - 1.49m | 1.5m - 2.8m | More than 2.8m | Don't know | Refused | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Less than 61,000** | **36%** | 14% | 13% | 7% | 6% | 2% | 3% | 8% | 5% | 6% | 100% |
| | **7%** | 5% | 11% | 12% | 14% | 9% | 11% | 20% | 5% | 6% | 100% |
| **61,000 - 99,000** | 20% | **25%** | 23% | 5% | 6% | 2% | 1% | 3% | 7% | 8% | 100% |
| | 7% | **5%** | 11% | 12% | 14% | 9% | 11% | 20% | 5% | 6% | 100% |
| **100,000 - 249,999** | 10% | 7% | **37%** | 18% | 5% | 2% | 2% | 3% | 8% | 9% | 100% |
| | 7% | 5% | **11%** | 12% | 14% | 9% | 11% | 20% | 5% | 6% | 100% |
| **250,000 - 499,999** | 3% | 2% | 10% | **43%** | 20% | 3% | 2% | 4% | 6% | 7% | 100% |
| | 7% | 5% | 11% | **12%** | 14% | 9% | 11% | 20% | 5% | 6% | 100% |
| **500,000 - 999,999** | 2% | 2% | 5% | 9% | **48%** | 14% | 5% | 4% | 4% | 6% | 100% |
| | 7% | 5% | 11% | 12% | **14%** | 9% | 11% | 20% | 5% | 6% | 100% |
| **1m - 1.49m** | 0% | 0% | 2% | 2% | 11% | **50%** | 22% | 5% | 4% | 4% | 100% |
| | 7% | 5% | 11% | 12% | 14% | **9%** | 11% | 20% | 5% | 6% | 100% |

| Survey response SBS2007<br><br>BSD value | Less than 61,000 | 61,000 - 99,000 | 100,000 - 249,999 | 250,000 - 499,999 | 500,000 - 999,999 | 1m - 1.49m | 1.5m - 2.8m | More than 2.8m | Don't know | Refused | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.5m - 2.8m** | 1% | 1% | 2% | 1% | 2% | 9% | **56%** | 20% | 4% | 5% | 100% |
| | 7% | 5% | 11% | 12% | 14% | 9% | **11%** | 20% | 5% | 6% | 100% |
| **More than 2.8m** | 0% | 0% | 0% | 0% | 1% | 2% | 6% | **82%** | 3% | 4% | 100% |
| | 7% | 5% | 11% | 12% | 14% | 9% | 11% | **20%** | 5% | 6% | 100% |
| **Total** | 7% | 5% | 11% | 12% | 14% | 9% | 11% | 20% | 5% | 6% | 100% |

**Pearson chi2(63) = 8.6e+03 Pr = 0.000**

## Table B10: Determinants of firm growth in turnover from 2007-2014, OLS estimators

| Dependent variable: ln(turn_2014)-ln(turn_2007) | OLS regression Δ turnover (%) | |
|---|---|---|
| **Independent variables** | **β** | **s.e.** |
| Employees (ln) | -0.143*** | 0.027 |
| Turnover (ln) | 0.130*** | 0.027 |
| Age | -0.003*** | 0.002 |
| Expectation for future turnover (decrease) | | |
| Stay the same | 0.132* | 0.062 |
| Increase | 0.268*** | 0.060 |
| Don't know/No answer | 0.073 | 0.118 |
| | | |
| Advice (d) | 0.048 | 0.035 |
| Training (d) | 0.099** | 0.041 |
| Management training (d) | -0.005 | 0.038 |
| Product innovation (d) | 0.019 | 0.033 |
| Process innovation (d) | 0.027 | 0.033 |
| Government support grant/loan (d) | 0.078* | 0.043 |
| Ease of obtaining finance (No recent finance) | | |
| No problems | 0.052 | 0.036 |
| Problems | -0.131* | 0.084 |
| Gender of management (male) | 0.065 | 0.060 |
| Family business (d) | -0.041 | 0.035 |
| Herfindahl Index | -0.002 | 0.007 |
| Manufacturing (d) | 0.056 | 0.036 |
| **Controls** | | |
| East of England | 0.046 | 0.054 |
| London (d) | -0.079 | 0.075 |
| North East (d) | -0.102 | 0.093 |
| North West (d) | 0.023 | 0.051 |
| South East (d) | -0.152* | 0.072 |
| South West (d) | 0.004 | 0.062 |
| West Midlands (d) | -0.200 | 0.086 |
| Yorkshire and the Humber (d) | 0.040 | 0.073 |
| Wales (d) | -0.021 | 0.060 |
| Scotland (d) | -0.026 | 0.068 |
| Northern Ireland (d) | -0.184 | 0.102 |
| Constant | 0.358 | 0.175 |
| Pseudo R2 | 0,044 | . |
| Chi-squared | 0.000*** | . |
| Observations | 4,215 | . |

Note: Robust standard errors. The East Midlands is the base category for the regions. *(d)* Dummy variable[19]. Significance levels: * 10%, ** 5%, ***1%. Based on SBS2006 data. OLS parameter estimates shown for OLS regression.

[19] Please see Annex Table B5 for a description of how the relevant dummy variables are created.

## Table B11: List of standardisation rules used in the reclink2 command before linking on business names

| Changes to "entity type" | | Changes to "standard names" | | | | Signs removed | Signs replace with space |
|---|---|---|---|---|---|---|---|
| Before | After | Before | After | Before | After | - | - |
| ASSC | ASSC | AIRPORT | ARPT | ADMINISTRATORS | ADMIN | ! | ( |
| ASSO | ASSC | CENTRAL | CTRL | ADMINISTRATOR | ADMIN | # | ) |
| ASSN | ASSC | COUNTY | CNTY | ADMINISTRATION | ADMIN | $ | . |
| ASSOC | ASSC | CENTERS | CTR | ADMINISTRATIVE | ADMIN | % | |
| ASSOCATES | ASSC | CENTRE | CTR | BROTHERS | BROS | ' | - |
| ASSICATES | ASSC | CENTRES | CTR | CONTRACTOR | CONTR | * | / |
| ASSOCIA | ASSC | CENTER | CTR | CREDIT UNION | CU | = | : |
| ASSOCIATES | ASSC | CENT ER | CTR | CR UN | CU | ? | ; |
| ASSOCIATION | ASSC | CNTRS | CTR | CHEMICAL | CHEM | @ | < |
| A SOLE PROPRIETOR | ASP | CNTR | CTR | CHEMICALS | CHEM | ^ | > |
| A SOLE PROPRIETORSHIP | ASP | GALLERY | GALR | DEPARTMENT | DEPT | _ | [ |
| SOLE PROPRIETORSHIP | ASP | FIELDS | FLD | DOTCOMS | DOTCOM | ` | \ |
| SOLE PROPRIETOR | ASP | FIELD | FLD | DOT COM | DOTCOM | ~ | ] |
| SOLE PROP | ASP | FLDS | FLD | ELEC | ELEC | | { |
| CO OPERATIVE | COOP | FORTS | FT | ELECTRIC | ELEC | | \| |
| CO OPERATIVES | COOP | FORT | FT | ELECTRICS | ELEC | | } |
| COOPERATIVE | COOP | HARBOR | HBR | ELECTRONIC | ELEC | | |
| COOPERATIVES | COOP | HEIGHTS | HTS | ELECTRONICS | ELEC | | |
| CO OP | COOP | HEIGHT | HTS | ENGINEERS | ENGR | | |
| COMPANY | CO | HGTS | HTS | ENGINEERING | ENGR | | |
| COMPNAY | CO | HGHTS | HTS | ENGINEER | ENGR | | |
| COMPANIES | CO | HOSPITAL | HOSP | ENTERPRISE | ENT | | |
| COMPAN | CO | INT L | INTL | ENTERP | ENT | | |
| CORPORATION | CORP | INTERNATIONAL | INTL | ENTERPRISES | ENT | | |
| COPORATION | CORP | INTERNATL | INTL | ENTERPRIZES | ENT | | |
| CORPORTATION | CORP | I NTERNATL | INTL | ENTERPRS | ENT | | |
| CORPORATE | CORP | INDUSTRIES | IND | ENTPR | ENT | | |
| CORPORATTION | CORP | INDS | IND | ENTR | ENT | | |
| ET AL PA | ET AL PTR | INDUSTRIAL | IND | ENTRPRSE | ENT | | |
| ET AL P A | ET AL PTR | INDL | IND | ENTRPSE | ENT | | |
| ET AL GEN PTR | ET AL PTR | LDG | LDGE | CREDIT UNION | FCU | | |
| ET AL PTR | ET AL PTR | LODGE | LDGE | GROUP | GRP | | |
| ET AL PTRS | ET AL PTR | MEADOWS | MDWS | INSURANCE | INS | | |
| ET AL PTNR | ET AL PTR | MNT | MT | LABORATORIES | LAB | | |
| INCORP | INC | MOUNT | MT | LABS | LAB | | |
| INCORPORATION | INC | MOUNTAIN | MTN | MANUFACTURING | MFG | | |
| INCORPORATED | INC | MOUNTAINS | MTN | MANUFACTURI | MFG | | |
| INCORPORAT | INC | MTNS | MTN | MANAGEMENT | MGT | | |
| LIMITED | LTD | NATIONAL | NATL | MANAGMENT | MGT | | |
| LTD PARTNERSHIP | LTD PTR | NAITONAL | NATL | MGMNT | MGT | | |
| PROFESSIONAL CORPORATION | PC | NATINAL | NATL | MGMT | MGT | | |
| PROF CORPORATION | PC | PLAZA | PLZ | PRODUCTS | PROD | | |
| A PROF CORP | PC | PLZA | PLZ | PRODS | PROD | | |
| PROF CORP | PC | PROFESSIONAL | PROF | SYSTEMS | SYS | | |
| PRT | PTR | REGIONAL | REG | .COM | DOTCOM | | |
| PRTSHIP | PTR | RIVER | RIV | A+ | APLUS | | |
| PRTSP | PTR | SAINT | ST | + | & | | |
| PTN | PTR | SAINTE | ST | @WORK | ATWORK | | |
| PTNR | PTR | SERVICES | SVC | | | | |
| PTNRS | PTR | SERVICE | SVC | | | | |
| PTNRSHIP | PTR | SER VICES | SVC | | | | |
| PTNSHP | PTR | SERV | SVC | | | | |
| PTRS | PTR | SVCS | SVC | | | | |
| PTRSHP | PTR | SHOPPING MALL | MALL | | | | |

| Changes to “entity type” | | Changes to “standard names” | | Signs removed | Signs replace with space |
|---|---|---|---|---|---|
| PTS | PTR | SHOP MALL | MALL | | |
| PTSHIP | PTR | UNIVERSITY | UNIV | | |
| PTSHP | PTR | | | | |
| SERVICE CORPORATION | SC | | | | |
| SERVICE CORP | SC | | | | |
| SVC CORP | SC | | | | |
| & AFFILIATES | & AFF | | | | |
| & AFFILIATED COMPANIES | & AFF | | | | |
| & AFFILIATED COS | & AFF | | | | |
| & AFFILIATED CO | & AFF | | | | |
| & ITS AFFILIATED COS | & AFF | | | | |
| & ITS AFFILIATED CO | & AFF | | | | |
| & SUBSIDIARIES | & SUBS | | | | |
| & SUBSIDIARY | & SUBS | | | | |
| & ALL OF ITS US SUBSIDIARIES | & SUBS | | | | |
| & ITS SUBSIDIARIES | & SUBS | | | | |
| & SUBSID | & SUBS | | | | |

# ANNEX C: Strengths and weaknesses of linking approaches

| **Companies House Linking 1** (Live register from Companies House website) | **Companies House linking 2** (Historic register from Opencorporates.org accessed through Google reconciliation) | **Interdepartmental Business** Register Linking (Address reference tables) |
|---|---|---|
| **Strategies tested** | | |
| • Fuzzy linking strategy 1, 2, 3 tested | • Fuzzy linking strategy 1 only feasible, as a method cannot incorporate postcode<br>• Postcode distance measure implemented post matching can get around this | • Fuzzy linking strategy 3 tested.<br>• Focus on the remaining non-links (non-limited businesses mostly) and poorly linked companies (distance >10) |
| **Weaknesses** | | |
| • Problematic for dead companies<br>• Problematic for working proprietors | • Problematic for working proprietors<br>• CRN link to IDBR, only around 90% | • Data heavy and time consuming<br>• Poor data documentation<br>• Not clear how changes to business names/addresses are recorded<br>• Access to data |
| **Link rates achieved** | | |
| • SBS 2006: 3,055/8,640<br>• SBS2007: 3,396/7,985 | • SBS 2006: 6,454/8,640<br>• SBS 2007: 5,660/7,985 | • Only tested on businesses remaining unmatched after CH match 1 and 2 |

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